Vegetation changes and woodland management associated with a prehistoric to medieval burnt mound (*fulachta fiadh*) complex at Ballygawley, Northern Ireland

ABSTRACT

This paper examines the impact on woodlands associated with burnt mound use from floodplain sediments and peats, using a combination of pollen, non-pollen palynomorphs, micro- and micro-charcoal and worked wood for the first time. We present this data from a multi-period burnt mound complex, dating from the Late Neolithic to the Medieval period, at Ballygawley, Co. Tyrone, Northern Ireland, to reconstruct vegetation changes from the Neolithic onwards to establish the significance of these changes, in particular on woodlands, whilst the burnt mounds were in use. The findings from the macroscopic charcoal suggests the most abundant trees were commonly, but not exclusively, exploited. Local woodland was seemingly unaffected by use of burnt mounds during the Neolithic and early Bronze Age based on pollen evidence. A sustained increase in microscopic charcoal coincides with a permanent decrease in alder-carr woodland during a period of near continuous burnt mound use between 1725 and 530 BC and a second phase of high microscopic charcoal values, c. AD 880, corresponds to the end of the penultimate phase of burnt mound use. Evidence from the worked wood indicates that some form of woodland management may have used for hazel from the Neolithic onwards.

Keywords: prehistory, medieval, burnt mounds, pollen, non-pollen palynomorphs, charcoal, woodland management, Northern Ireland.

INTRODUCTION

Burnt mounds or '*fulacht fiadh*' are a common feature in the Irish and British archaeological record (Brindley *et al.* 1989; Buckley 1990; Feehan 1991), dating from the Neolithic to the medieval period (Anthony *et al.* 2001; Ó Néill 2009), but their function has been long debated (see Hawkes 2013) and as such they remain an archaeological enigma. Until, recently, few palaeoenvironmental studies have focussed specifically on understanding the function and wider environmental context of burnt mounds (e.g. Innes 1998; Gonzalez *et al.* 2000). Brown *et al.* (2016) summarises some of the recent palaeoenvironmental work done in Ireland and suggests that the most likely function of burnt mounds studied was textile production or activities related to hide cleaning and tanning. Wheeler *et al.* (2016) also used a palaeoecological approach to place a number of Late Neolithic and Early Bronze Age burnt mounds into an environmental context at two locations in County Tyrone, Northern Ireland. Palynological results from their study showed that activity horizons at each site shared similar characteristics: high microscopic charcoal values, repetitive fluctuations in tree and shrub taxa, increased *Sphagnum*, and the presence of non-pollen palynomorphs (NPPs), all of which could be diagnostic indicators of burnt mounds in palynological records. While the data did not allow Wheeler *et al*. (2016) to ascribe a specific function for the burnt mounds, the 'seesaw' pattern of tree and shrub pollen, combined with the macroscopic charcoal data, indicate possible species selection and management of the local woodland species for fuelwood.

This study focusses upon a burnt mound complex at Ballygawley, where activity dates from the Late Neolithic to the medieval period. We present microfossil data from a new sampling site within the burnt mound complex, together with new charcoal (spanning the mid Bronze Age to the medieval period) and wood technology data (from burnt mound troughs). The aims of the paper are to: (i) reconstruct the vegetation history of a burnt mound complex using pollen, NPPs, microscopic charcoal data and anthracological data; (ii) examine the wood types and technology used in trough construction, specifically in relation to woodland management (iii) identify vegetational changes, particularly on woodlands, associated with the use of the burnt mounds and (iv) compare the results found in this new investigation to those presented in the previous investigation of the same burnt mound complex by Wheeler *et al*. (2016).

The term 'burnt mounds' is used throughout the paper 'to refer to a site which contains one or more mounds or stone-spreads containing burnt or heated stones with, or without, an associated trough or pit but with no connotation as to function' following Brown *et al*. (2016:3).

ARCHAEOLOGY AND SITE DETAILS

Palaeoenvironmental sampling was carried out as part of the archaeological evaluation and excavation strategy associated with the A4/5 road improvement scheme between Dungallen and Ballygawley, Co Tyrone, Northern Ireland, undertaken by Headland Archaeology Ltd (Figure 1).

The site is located in low lying pasture land several hundred metres east of the Ballygawley Water, on the edge of the floodplain at the foot of higher ground formed by drumlin topography where layers of peat were discovered, overlain by alluvial silts and clays. Prior to excavation the site was well-drained pasture with a diverted stream, which archaeological excavation and the analysis of historical maps suggesting that it is a modern diversion of a natural meandering stream present on site for over c. 5000 years. A number of palaeochannels and alluvial islands that formed a migrating channel system were recorded. Radiocarbon dating has shown that the channels represent the various stages of a migrating channel system, which has generally moved southwards over time, and that the site was used from the Late Neolithic to the medieval period. Within the channel system, 23 burnt mound groups were discovered, together with ten timber and wattle-lined troughs with associated pits and hearths (Bailey 2010; Bamforth *et al.* 2010). A radiocarbon chronology of these features indicates that they were used from c. 3350 BC to AD 1270 (Wheeler *et al.* 2016). The earliest radiocarbon date from a burnt mound is dated to 2897-2671 BC (GU-17361) and the youngest has been dated to AD 1041-1220 (GU-17375) (Figure 2; Table SI1). Of those burnt mounds radiocarbon-dated, 10 were in use during the Neolithic and Copper Age, 12 during the Bronze Age, 4 in the Iron Age and 5 in the medieval period. Some burnt mounds were in use during more than one archaeological period. A hiatus of activity of approximately 900 years occurred between the late Iron Age and early medieval period at the site, yet the overall longevity of activity indicates that people returned in order to use hot stone technology. A monolith of 168 cm depth, named BG-M1, was taken from a section to the east of the majority of excavated burnt mounds (Figures 1 and 3). It is located close to several burnt mounds approximately 20 metres to the north-east and south west: BM9003 is dated to the Late Neolithic and BM9009 has been dated to the Early/Middle Bronze Age (Table SI1). No burnt mound deposits were found at BG-M1 so the stratigraphy comprises deposits of peat, alluvial silts and clays. The stratigraphical relationship between BG-M1 and burnt mounds 9003 and 9009 can be seen in Figure 3.

METHODS AND MATERIALS

Microfossils

Sub-samples from BG-M1 were taken over 5 cm intervals. Each 1 cm^3 sub-sample was prepared for microfossil analyses following Barber (1976) including the additional step of density separation (Nakagawa *et al.* 1998). A sum of 500 total land pollen (TLP) was achieved for all sub-samples. Data are expressed as a percentage of the TLP, with spores and aquatic taxa excluded from the TLP sum. NPPs were also counted during routine pollen analysis (cf. van Geel 1978; van Geel *et al.* 1982/1983, 2003) and they are expressed as a percentage of TLP plus total NPPs. Rare types are indicated by a cross (+), where one cross is equal to one pollen grain or NPP. Microscopic charcoal was counted in three fractions (<21µm, 21-50µm, and >50µm). Identification, including cereal-type pollen, was aided by reference keys in Fægri *et al.* (1989), Moore *et al.* (1991), Beug (2004) and Reille (1999), and supported by a modern type-slide reference collection housed at the University of Aberdeen. As the separation of *Myrica gale* from *Corylus avellana*-type can be difficult these pollen grain types are classified as *Corylus avellana*-type (Edwards 1981). Plant nomenclature follows Stace (2010). Basic land use designations interpreted from the pollen records follow Brown *et al.* (2007). Loss on Ignition percentages (LOI) were also determined (Schulte and Hopkins 1996).

Radiocarbon dating

Selected bulk sediment and charcoal samples were carefully extracted from monolith 1 and submitted to the SUERC Radiocarbon Laboratory and Poznań radiocarbon laboratory for AMS radiocarbon dating by the authors (Table 1). A total of 62 dates were previously available from archaeological features from Ballygawley (Bailey 2010), including 43 dates from burnt mounds (mainly of macroscopic charcoal fragments), with 11 dates from waterlogged worked wood (Tables SI1-2).

Macroscopic charcoal

A maximum of fifty charcoal fragments of a size >0.5mm were selected from each archaeological bulk sample to allow for species identification and to maximise ring curvature data. The standardised quantitative sampling strategy (following Asouti 2001 and Wheeler 2007) was deemed appropriate to provide adequate material for inter-feature/inter-site assessments. Standard methods of identification followed Leney and Casteel (1975) with charcoal samples being fractured to reveal the three sectional surfaces (transverse section (TS), tangential longitudinal section (TLS), and radial longitudinal section (RLS) necessary for microscopic wood-type identification to genus. Charcoal fragments were securely positioned onto slides for examination under an incident light microscope at magnification 100x, 200x and 400x. Identifications, assisted by using wood keys, and nomenclature followed Schweingruber (1990) and a modern reference collection. Ring curvature was measured using the key in Marguerie and Hunout (2007): where weak curvature is thought to denote large-sized timbers (trunkwood); medium curvature, medium-sized timbers (large branch wood); and strong curvature representative of small-sized timbers (small branch wood and twigs). When ring curvature could not be observed or genus not identified, an indeterminate result was recorded.

Waterlogged Wood

Samples of waterlogged timbers from troughs associated with the burnt mounds were taken during excavation to provide information on the species selected for construction materials, evidence of wood working technology and preservation condition. All of the wood was recorded using specially devised worked wood recording sheets, where measurements were taken of the wood dimensions, together with observations on morphology and construction style. Preservation of worked wood has been graded using the condition scale developed by the Humber Wetlands Project (Van de Noort *et al.* 1995). All of the wood samples were identified using the same methodology as the charcoal identifications; with wood sections being bleached prior to mounting on slides in order to view the wood anatomy.

RESULTS

Radiocarbon Dating

All radiocarbon dates from the BG-M1, charcoal and wood quoted in this paper are listed in Figure 2 and Tables 1, SI1 and SI2, and calibrated using OxCal 4.2 (Bronk Ramsey *et al.* 2013) and IntCal 13 atmospheric curve (Reimer *et al.* 2013). An age-depth model for the BG-M1, constructed using CLAM (Blaauw 2010), is shown in Figure 4.

Whilst limited in number, the radiocarbon dates associated with the monolith sequence are coherent in terms of chronological integrity. Clearly, more radiocarbon dates would improve the robustness of the CLAM age-depth model (Figure 3), therefore the model should be treated with caution. The top of the monolith is assumed to represent the present day and the uncertainty of the ages, based on the difference between the calibrated minimum to maximum age per centimetre, varies by up to approximately 180 years in the lowermost samples but is much lower, at approximately 90 years per centimetre between 63 and 36 cm. When interpreting sedimentary archives, Telford *et al.* (2004) and Piotrowska *et al.* (2011) consider that all dates and all models are uncertain. This must also be borne in mind when comparing the palaeoenvironmental chronologies with the archaeological ones in this study. Unless stated otherwise all cited ages are calibrated (2σ) and/or derived as best estimates from the CLAM model for the microfossil data.

The chronological periods used in this paper follow Eogan and Shee Twohig (2011).

Stratigraphy

A brief description of the BG-M1 is provided in Table 2. The monolith was taken through a series of intercalated clays, silts and wood peats assumed to be representing phases of acquiescence, channel activity and subsequent infill following the shifting of the channel.

Microfossils

The BG-M1 pollen and NPP diagrams were constructed using Tilia.graph (Grimm 2004) and are presented in Figures 5, 6 and 7. The diagrams have been divided into local pollen assemblage zones (LPAZs) using CONISS (Grimm 1987). The interpretation of floodplains and terrace depressions is hindered by problems of differential preservation, productivity, transport and source areas. Pollen preservation is variable across all zones (Brown 1997). Whilst the condition of pollen grains showed signs of deterioration, identifiable counts of 500 TLP were achieved throughout the sequence (Delcourt and Delcourt 1980; Jones *et al.* 2007). However, the proportion of unidentifiable grains – classed as degraded, corroded, folded/crumpled and broken - are quite high in the BG-M1 pollen record (Figure 7). Bunting *et al.* (2001) proposed several criteria for determining whether soil pollen samples are reliable or not. They suggested that high levels of indeterminate grains (>45% TLP) in a soil pollen sample would be a reason to reject samples as they suggest any interpretation of that data would be unreliable. Using this sole criterion some of the levels in the BG-M1 pollen record, especially those sampled from minerogenic sediments, would be rejected. Other categories indicate the pollen record from BG-M1 is reliable. The proportions of resistant (thick-walled) taxa are low – indeed grasses (whose walls are thin) are well preserved. Tipping *et al.* (1994) and Bunting *et al.* (2001) also suggest that values of >40% TLP Pteropsida undiff. would compromise the reliability of the pollen record but at BG-M1 the values of this spore are <20% TLP. Tipping *et al.* (1994, 1999) also suggest that the pollen record is possibly unreliable if taxonomic diversity is low but again this is not an issue for BG-M1.

Brown (1997) adapted Jacobsen and Bradshaw's (1981) model of pollen recruitment for palaeochannels. The model predicts that the majority of pollen will be derived from local sources (70-80% total pollen), with minor contributions from extra local and regional sources. Pollen sources for a peat under a canopy of wet woodland (which characterises BG-M1) are considered to generally reflect local and extra local pollen. Determining the pollen source area for the silts and clays at BG-M1 is more complicated and little research exists. Perhaps the most representative model of the deposits at BG-M1 was proposed by Brown (1997). Based on Tauber's (1965) model for a small oxbow lake with a small stream input, Brown suggests that pollen contributions come from a long distance, regional component as well as a canopy, trunk space, local fringing vegetation and waterborne component (which could include pollen from the whole catchment) but the contribution of each source is not defined. Catchment connectivity can also change through time as a result of human activity and this can lead to a non-linear response to sediment (and presumably pollen) delivery from source areas to a water body (Pittam *et al.* 2006; Turnbull *et al.*, 2008). Bonny (1978) and Pennington (1979) suggest that incoming streams provide the major portion of pollen (up to 85%) to a lake. At BG-M1 there are no major or rapid changes in the pollen record as a result of a change in the stratigraphy to suggest these issues have compromised the pollen record. It is unlikely floods have compromised the BG-M1 pollen record. Brown (1985) suggests that despite flood waters containing high concentrations of pollen, an examination of a silt deposited by a flood actually contained very little pollen and most of the pollen ends up in a lake or pond. Therefore, we suggest that the BG-M1 pollen record is a reliable proxy for vegetation change at the site and this is supported by the charcoal and the wood data.

INTERPRETATION

BG-M1: vegetation and land use change

LPAZ *BG1pc (162-112 cm) 2760-1765 BC*

Results from the age-depth model suggests that this LPAZ spans part of the Neolithic and Early Bronze Age (Figures 5-7). Tree and shrub percentages fluctuate around 60% TLP and indicate a local pollen source (cf. Martin and Mehringer 1965). High values of *Alnus* and possibly *Corylus avellana*-type pollen, with trace amounts of *Salix* are indicative of a local carr/wet woodland (Waller *et al.* 2005). Woodland, characterised by *Quercus*, *Corylus avellana*-type, with lesser amounts of *Betula* and *Ulmus*, was probably situated on higher ground. *Polypodium* occupied shaded areas beneath the woodland canopy. Rough, wet pasture and/or fens are inferred by the representation of Poaceae, *Plantago lanceolata*, Ranunculaceae, *Rumex acetosa*, Caryophyllaceae, Cyperaceae, *Peucedanum palustre*-type and *Filipendula* (Brown *et al.* 2007; Stace 2010).

Arable activity is suggested with the sporadic occurrence of cereal pollen, albeit in trace amounts. Poaceae grains (>35 µm in diameter) were recorded: these could be wild grasses, such as *Glyceria* and *Elytrigia,* which are found in wet meadows (Stace, 2010; Tweddle *et al.* 2005). Microscopic charcoal counts, indicative of burning, was consistently recorded in all fractions. Wood detritus can be inferred from the occurrence of scalariform perforation plates (SPPs) (HdV-114) and grazing is indicated by coprophilous *Cercophora*-type (HdV-112). *Sordaria*-type (HdV-55A) suggests grazing and/or decaying wood. *Glomus* cf. *fasciculatum* chlamydospores (HdV-207) may also represent an inwash of debris as this particular NPP is considered to be a marker for erosion in fluvial/lacustrine contexts (van Geel *et al.*, 1983, 2003).

Gloeotrichia (HdV-146), an aquatic pioneer indicative of nutrient poor conditions, which has the ability to fix nitrogen (van Geel, 2005) featured consistently. *Sphagnum* spores and the occurrence of *Tilletia sphagni* (HdV-27) were recorded. Radiocarbon dates from Ballygawley indicate c. 12 burnt mounds were in use between 2897-2671 BC (GU-17361) and 1883-1693 BC (GU-17354) (Table SI1; Figure 2) therefore the changes described above could be associated with contemporary burnt mound use.

LPAZ *BG2pc (112-65cm) 1765-830 BC*

The age-model model tentatively places this zone in the Bronze Age. After an initial increase in arboreal pollen at the beginning of the LPAZ, a permanent loss of woodland cover is indicated by the very gradual decline in total arboreal pollen percentages, predominantly *Alnus*, culminating with a sharp decline across the LPAZ BG2pc/BG3pc boundary. This coincides with burnt mound use from c. 1745-1566 BC (GU-18396) to 1108-896 BC (GU-17368) (Figure 2; Table SI1). *Sphagnum*, commonly associated with wet environments, occurs in low amounts, was used as a lining in the burnt mound troughs. Low percentages of HdV-114, which derive from decayed wood were recorded, whilst *Gloeotrichia* (HdV-146) indicative of nutrient poor water was more abundant.

No cereal-type pollen was identified although the occasional trace of Poaceae >35µm may be representative of cereal-types and/or wild grasses (Dickson 1988; Edwards and Borthwick 2010), possibly in wet meadow/fen or within the floodplain system along with Cyperaceae, *Filipendula* and *Peucedanum palustre*-type. Low amounts of possible pasture (*Plantago lanceolata*, Lactuceae) and/or disturbance indicators (e.g. Chenopodiaceae) were recorded. *Sordaria*-type (HdV-55A) was recorded at the start of the LPAZ suggesting low intensity grazing and/or the presence of decayed wood. *Glomus* cf. *fasciculatum* chlamydospores (HdV-207) may be associated with the inwash of eroded material in the upper part of the LPAZ. A phase of intense burning is suggested by the microscopic charcoal peak at 72 cm.

LPAZ *BG3pc (65-4 cm) 830 BC – ?)*

The age range of this zone is uncertain given the lack of radiocarbon dates for the top 34 cm, but if sediment deposition was continuous, admittedly unlikely in a floodplain environment, the age-depth model suggests it can be placed from the Late Bronze Age throughout to at least the medieval period. There are three phases of burnt mound use during this period; the tail end of Late Bronze Age activity from 774-434 BC (GU-17343) to 756-413 BC (GU-17370); Iron Age trough 9037 at 384-204 BC (GU-18393); then an apparent hiatus in use until AD 663-859 (GU-17356) to AD 1041-1220 (GU-17375).

Alnus percentages failed to recover to their LPAZ BG2pc values, so total tree pollen percentages remain at approximately 20% TLP, with other tree taxa largely unaffected (Figure 5). A slight increase in *Alnus* and *Corylus avellana* at c 30 cm suggests that some woodland regeneration took place. Wet pasture/marsh indicators were present including Poaceae >35 µm, *Rumex acetosa* and *Plantago lanceolata*, Cyperaceae, *Filipendula*, *Galium*-type and *Peucedanum palustre*-type, together with those of disturbed ground, such as Chenopodiaceae, Lactuceae and Apiaceae (Figure 5) (Brown *et al.* 2007). *Agropyron*-type (wheat-grass) is recorded and it is possible that it was used by humans as the leaves, tuber and seeds are edible, and the roots also produce a grey dye (Coon, 1978). Alternatively, species within this genus can be found naturally along river banks in shade (National Museums Northern Ireland, 2010). Coprophilous fungi, *Cercophora*-type (HdV-112) and possibly *Sordaria*-type (HdV-55A), were also recorded from 40 cm onwards suggesting that herbivores grazed nearby (Mighall *et al.* 2008). *Sphagnum*, SPPs (HdV-114) and *Gloeotrichia* (HdV-146) both feature (Figure 7).

An immediate decline in microscopic charcoal in this zone suggests that natural fires or the use of the burnt mounds subsided briefly, potentially corresponding with a lack of archaeological evidence for their use. Microscopic charcoal rises again to 38 cm before falling to lower values which might be connected to burnt mound use (Figure 5). The radiocarbon dates from BG-M1 and the burnt mounds signal renewed activity at c. AD 1020. Although a fall in microscopic charcoal >50 µm fraction during the early stages of LPAZ BG2pc implies less intense burning in the immediate vicinity, more distant burning, most probably within the wider burnt mound complex, is suggested by an increase in the <21 μm and 21-50 μm fractions. This activity coincided with a gradual decline in woodland cover. SPPs (HdV-114) and *Gloeotrichia*-type (HdV-146) were also regularly recorded but at much lower values (Figure 7).

Macroscopic charcoal

The charcoal results presented are collated from burnt mounds and associated features (e.g. troughs and pits) dating from the Neolithic to medieval period (see supplementary data) and are shown in Figure 8. Notwithstanding the limitations of the age-depth model, they are of broadly comparable age to the BG-M1 pollen sequence.

The condition of the charcoal varied from firm and well preserved to poor and friable. In some cases, charcoal fragments were partially vitrified, caused by exposure to temperatures in excess of 800°C (Prior and Alvin 1983). A fraction of the charcoal assemblage was in a poor condition due to orange mineral discolouration, a common feature associated with material from burnt mounds, as waterlogged conditions can result in the charcoal incorporating minerals, such as calcium and iron, which hinders identification (Stuijts 2007). The anthracological information gained from the charcoal analysis provides a complementary data set to the pollen analysis and reveals the presence of insect-pollinated arboreal taxa such as Maloideae sp. fruitwoods, *Sorbus* sp. and *Prunus* sp. Trace amounts of *Prunus*-type are regularly recorded in the pollen record as well. However, these taxa are low pollen producers, with their pollen being difficult to detect unless they grow close to the sampling site (Stuijts 2007).

2153 charcoal fragments were analysed from a total of 26 burnt mounds (Figure 8). Eleven different taxa (together with *Salix/Populus* and indeterminate types) were identified as fuelwood from 1205 charcoal fragments analysed from 10 burnt mounds deposits dating to the Neolithic period; from 2897-2671 BC (GU-17361) to 2455-2147 BC (GU-18404). *Alnus glutinosa* is the dominant taxa identified in the wood fuel assemblages from this period with ring curvature indicating that branch wood was largely used together with a relatively, smaller amount of trunk wood. *Corylus avellana* is the second most used tree type for wood fuel (matching their relative abundance in the pollen record), with ring curvature again indicating it is mostly branch wood that is being utilised with some trunk wood. Significant quantities of *Quercus* sp., *Prunus avium* and *Prunus padus* were also identified, with ring curvature showing a similar trend to that of *Alnus* and *Corylus* (Figure 8). Branch wood of *Ulmus* sp., *Prunus spinosa*, *Sorbus* sp., Maloideae sp. (a group including *Pyrus communis* , *Malus sylvestris* and *Crataegus* sp., which cannot be differentiated based on their anatomical composition) and *Salix* sp., while trunk wood of *Betula* sp. was used together with branch wood.

655 charcoal fragments were analysed from across 11 burnt mounds deposits dating to the Bronze Age, from 1745-1566 BC (GU-18396) to 1108-896 BC (GU-17368). 13 taxa are present in the wood fuel assemblage, with *Alnus glutinosa* again the dominant taxon, followed by *Corylus avellana*-type. Charcoal fragments of *Prunus*

avium and *Prunus spinosa* are also present together with *Quercus* sp., *Betula* sp., Maloideae sp. and *Salix* sp. *Fraxinus excelsior*, *Populus* and *Ilex aquifolius* are only recorded in the Early Bronze Age assemblage, together with *Ulmus* sp. The ring curvature information for the Bronze Age shows an absence of trunk wood used for fuel with predominantly branch wood indicated as being utilised (Figure 8).

53 charcoal fragments were analysed from two Iron Age burnt mound deposits, dating from 774-434 BC (GU-17343) to 756-413 BC (GU-17370) (Figure 2). This more limited assemblage in comparison to those of the other periods suggests that small branch wood of 5 taxa. *Alnus glutinosa*, *Corylus avellana*, *Prunus avium* and *Prunus spinosa* were the main wood fuel utilised, together with a smaller amount of *Betula* sp (Figure 8).

The analysed charcoal fragments from the medieval period comprised 240 fragments; smaller than the Neolithic and Bronze Age assemblages. Seven taxa were present from 3 burnt mounds, dating between AD 1025-1157 (GU-17349) and AD 1041-1220 (GU-17375) (Figure 2). The assemblage is dominated by *Alnus glutinosa* with ring curvature information indicating that small branch wood was the main part of the tree being utilised, although trunk wood and larger branch wood were also used. Significant quantities of small branch wood of *Corylus avellana* and *Salix* sp. are also present, with smaller amounts of small branch wood of *Betula* sp., *Prunus avium* and Maloideae sp. together with indeterminate sized wood of *Quercus* sp (Figure 8).

Waterlogged Wood

The results of the identifications undertaken from the worked wood recovered from the troughs are presented in Figure 9. 207 items, including planking, revetting and stakes were identified from the 246 items sampled during the excavation; the remainder being deemed too poorly preserved to identify. Details of the troughs, associated radiocarbon dates, construction methods and evidence for wood working are provided in Table SI3.

The material examined scored between 1 and 4 on the Humber Wetlands condition scale and indicates that there has been a significant loss of data (Table SI3). The majority of the material examined is in a moderate condition, scoring 3, and is suitable for species identification and ring counts, although the primary conversion is likely to be apparent, much of the evidence for tooling may have been lost. Material scoring 1 or 2 is in very poor to poor condition, where no evidence of tooling can be seen and the primary conversion is often difficult to see.

Three troughs date to the Neolithic period (Figure 9; Table SI3). Wood identifications from the earliest trough (9939) suggest it was constructed mainly from *Alnus glutinosa*, together with Maloideae. *Corylus avellana* was used to construct Trough 9946 and in 9869 with *Alnus glutinosa*. The first recorded use of *Salix/Populus* is also identified from Trough 9946. Trough 9147, dating to the Early Bronze Age, shows the first recorded use of *Quercus* as a construction material with *Alnus glutinosa*, *Corylus avellana* and *Salix/Populus* continuing to be used. There are two troughs dating to the Middle Bronze Age. Trough 9687 is almost exclusively constructed from *Quercus*, with some *Alnus glutinosa*, while *Quercus* is absent in Trough 9812, which has been made from *Alnus glutinosa* and *Corylus avellana*. *Corylus avellana* is the sole construction material from the wattle Trough 9037, which dates to the Iron Age. A mix of construction materials is shown in the three troughs from the medieval period with the first use of *Fraxinus* recorded from Trough 9067, while *Alnus glutinosa* is the main material used, similar to troughs from the Early Bronze Age and Neolithic period, together with *Salix/Populus*. Trough 9590 is largely constructed from *Alnus glutinosa* with some *Corylus avellana*. The youngest trough (9578) sees the reappearance of *Quercus* as a construction material, with *Alnus glutinosa* used and possibly *Corylus avellana*.

There are six different trough construction styles recognised from the ten troughs excavated at Ballygawley; although all troughs have an individual style (Table SI3) which might imply different uses (Brown *et al.* 2016). Plank floors and wattle lining are recognised from two Neolithic troughs (9939 and 9869), with one trough (9939) having a double-lined timber floor. The timber flooring of these troughs is largely constructed from *Alnus glutinosa* with some *Corylus avellana* and Maloideae. Wattle lined troughs are recorded in the Neolithic (9946; 9869) and Iron Age (9037) with the wattle being constructed from *Corylus avellana*. Plank flooring with wattle revetment is identified from an Early Bronze Age trough (9147) that also has stakes driven through the plank floor. The plank flooring is constructed entirely from *Quercus*, which dendrochronological analysis has shown all comes from the same tree (Bamforth *et al.* 2010). The wattle has been constructed from a mix of *Alnus glutinosa*, *Corylus avellana* and *Salix/Populus*. Troughs with timber floors and revetting have been identified from the Middle Bronze Age (9812) and medieval period (9067 and 9590). The Middle Bronze Age trough has planking and stakes of *Alnus glutinosa* and *Corylus avellana*, while the medieval troughs have planking of *Alnus glutinosa*, *Fraxinus, Corylus, Salix/Populus*, with Trough 9067 having revetting stakes made from *Alnus glutinosa*, *Corylus avellana* and *Fraxinus*. Plank lined troughs with no wattle or revetment have been identified from the Middle Bronze Age (9687) and medieval (9578) periods. The Middle Bronze Age trough is constructed solely from *Quercus*, while the medieval trough is constructed from a mix of *Alnus, Corylus* and *Quercus* planks.

Examination of the construction materials sampled from the troughs points towards evidence for woodland management from the Neolithic period onwards (Table SI3). All of the sampled wattle suggests that the hazel was derived from coppice. Stakes from revetted troughs also had morphological features associated with coppicing or draw felling, although Out *et al.* (2013) recommends caution when inferring coppicing based on ring count/diameter studies of roundwood. Ring counts conducted on 4 rods taken from wattle used in Middle Bronze Age. Trough 9147 indicate rods were between 5 and 10 years in age and 9 wattle rods from Iron Age Trough 9037 show the rods were from 2 to 10 years in age. Given the uniform size of the rods, it appears that they were selectively cut from wood of a certain size.

DISCUSSION

Neolithic and Copper Age

Radiocarbon dates suggest that ten burnt mounds were in use in the Neolithic period and Copper Age between 2897-2671 BC (GU-17361) to 2455-2147 BC (GU-1840) (Figure 2). The macroscopic charcoal record shows an overwhelming use of alder with largely branch wood being exploited. Trunk wood of hazel is the second most common wood fuel used in the burnt mounds, with lesser amounts of oak, birch, bird- and wild cherry also exploited.

The pollen from BG-M1 shows a gradual increase in alder during the Neolithic onwards and the removal of branch wood for burnt mound fuel seems to have had no impact on woodland cover (Figure 5), despite 10 burnt mounds operating at this time, which is consistent with the pollen data presented nearby (Wheeler *et al.*, 2016). This suggests that exploitation of trees for wood was not of sufficient intensity to register an impact in the pollen record at this time. The worked wood evidence shows the use mainly of alder and hazel for trough construction (Figure 9). There are fluctuations in the pollen record for hazel that may relate to the removal of branches or the trees, or result from natural fluctuations. The impact on other trees within the landscape, such as oak, cherry, birch and elm trees, is harder to discern given their paucity in the pollen diagram but the pollen and charcoal records suggests evidence of their local presence and use.

The woodworking recorded from the Neolithic structures is all of a basic nature. Timbers have been converted using simple, unmodified splits. Items have been trimmed to length using an edged tool, presumably a hafted stone axe (likely also used in the felling of trees). There is no evidence for complex carpentry in the form of either more complex conversions, jointing or finishing (Table SI3). The structures have not been keyed together in any way. As alder and hazel were the dominant arboreal taxa in the pollen record, the material in the burnt mounds were probably sourced locally (cf. Ludemann *et al.* 2004; Ludemann 2009). There is no evidence for woodworking debris on site, raising the possibility that the timbers may have been fashioned to some extent prior to trough construction.

Bronze Age

The charcoal data shows a more varied use of tree types for fuel during the Bronze Age with ash, poplar and holly being recorded for the first time (mainly in the Early Bronze Age). All the charcoal analysed is indicative of branch wood with no evidence of any trunk wood being used, which suggests a carefully managed strategy for the supply of fuel wood. However, the total arboreal pollen percentages decline during the Bronze Age (start of LPAZ BG2pc), largely caused by decreasing *Alnus* until 530 BC, a pattern not observed in the other arboreal pollen taxa (Figure 5) and in the other pollen record at Ballygawley (Wheeler *et al.*, 2016). A more rapid decline in *Alnus* coincides with a sustained increase in microscopic charcoal (peaks at 1030 BC; LPAZ BG2pc, 72 cm) before returning to lower values by 530 BC.

Despite hazel being widely utilised for fuel in the Bronze Age, no major decline is evident at BG-M1. Willow is also consistently used in the construction of the troughs but it is under-represented in the pollen diagram being insect pollinated, so impact on this taxon is harder to discern. Cherry trees continue to be frequently utilised. Brown *et al.* (2016) concluded that hide production and tanning was the most probable use for *fulacht fiadh*, and, if so, cherry could have been used for its aroma to mask the smells of butchery. 16 flint scrapers and two bone points indicative of butchery practices and hide preparation were found at the site. Butchery is also indicated by the faunal bone assemblage, which consists of cattle, pig and sheep/goat, largely contains parts associated with slaughter (skull, mandible, lower leg bones) and primary butchery (upper leg bones) (Tourunen 2009), although the lack of blades recovered suggests meat preparation was not taking place (see Lochrie in Bailey 2010).

The worked wood identifications show an increase in the use of oak during this period, including trough 9687 that was constructed entirely from one oak trunk (Figure 9, Table SI3). Trough 9147 was also constructed from oak and dendrochronological analysis cross-matched 5 of the timbers and gave a felling date of 1590 BC (Bamforth *et al.* 2010). The use of elm for fuel is only seen in the Early Bronze Age within burnt mound BM9373 dated to 1746-1535 BC (GU-17363). *Ulmus* (elm) pollen only occurs in trace amounts within both pollen diagrams (Figure 5 and Wheeler *et al.* 2016) suggesting that elm was a minor constituent of any local woodland.

There seems little qualitative difference in the woodworking between the Neolithic and Early Bronze Age/Middle Bronze Age assemblages, which are again fairly basic with a lack of finishing, jointing or other complex carpentry observed across all troughs (Table SI3). However, the timbers of oak within these assemblages are seen to be cleaved in a more complex manner and from larger trees and the introduction of metal tools would have made the felling of large oaks an easier task.

The Late Bronze Age sees a change in woodworking technology and a broader shift in the selection of raw material – which matches the charcoal evidence for wider fuel resource. There is a significant variation in both size and form, from the smaller, oval earlier troughs to larger, rectangular troughs. However, there is still some parity in depth, with the troughs from this period varying between 0.15 m and 0.30 m deep. In terms of revetting, there was a shift away from wattle-lined troughs to plank-revetted troughs. Structure C9189 has plank-revetted sides, held in place by retaining stakes. The base of this trough was lined with large, split planks (Table SI3).

Trough 9764 is lined with a single oak timber, the largest encountered on site, measuring 3400 mm x 980 mm x 100 mm. This tangentially split timber was lying bark face down, split face up. Cleaving timbers of this size requires not only great skill, but also access to straight grained, knot free, high quality timber. This shift in raw material selection may well represent a change in resource exploitation away from smaller, understorey material possibly within the alder carr-woodland towards larger, stands of oak woodland. Although both taxa are represented in the pollen diagram, there are only minor fluctuations in their percentages.

Iron Age

The charcoal data from two burnt mounds dated to between 774-434 BC (GU-17343) and 756-413 BC (GU-17370) show a limited fuel assemblage of alder, hazel, blackthorn and wild cherry, together with some birch (Figure 8). The fuel assemblage was branch wood suggesting a continuity of fuel selection. There is an overall decline in the use of alder from the Middle Bronze Age through to the Iron Age (Figure 8): this coincides with a permanent decline in *Alnus* pollen percentages across the late Bronze Age/early Iron Age transition (base of LPAZ BG3pc). Brown *et al.* (2016) suggest the clearing of wet woodland surrounding burnt mounds for fuel resources commonly took place.

Apart from an increase in Poaceae and the first occurrence of Lactuceae, there is little response from the non-arboreal taxa normally associated with human activity or disturbance during the decline of *Alnus*. Microscopic charcoal values showed a rise across all fractions as tree pollen percentages decrease. Burnt mounds and hearth use seems to be the most likely explanation but it is not clear whether this represents a fire deliberately set by humans or a natural occurrence (cf. Chambers, 1993) but Edwards *et al.* (2005) argue that sustained high levels were more likely to be the result of humans.

Hazel is still well represented in the pollen record and seemed to maintain its presence in the landscape during the Iron Age. This might be the product of some form of deliberate management but it is hard to tell from pollen data alone (Waller *et al.* 2012). The best evidence for potential woodland management came from the hazel rods used to construct Trough 9037; dated to 384-204 BC (GU-18393) (see Table SI3 and Figures 9, 10). The most frequent ring count was four and the most frequent diameter range was from 10 mm to 15 mm. The variation in diameters was smaller than in ring counts from hazel stakes used in other troughs. Taken together, this evidence strongly suggests either coppicing or selective cutting of wood based on size. It is possible for a coppice stool to have stems of similar size but with very different numbers of rings due to some shoots being overshadowed by older, taller shoots (O'Sullivan 1996). This may have been the case in this feature. This trough is perhaps the most enigmatic at Ballygawley with a woven wattle hazel frame underlined with *Sphagnum*. The use of moss to line both the base of the trough and the upstanding wattle sides is a departure from the typical trough construction on site and it may indicate a different use compared to the other troughs. It is possible that the moss may have acted as a filter for water upwelling into the trough providing a relatively clean water supply. The requirement for screening of the trough by the high sides and the greater depth of this trough both suggest rather different activities going on here from the other burnt mounds.

The majority of the rods used in all trough construction is indicative of harvesting the locally available wood mostly between four and seven years old and with diameters from 10 mm to 30 mm. The wood could have been harvested in a one off operation, with similar sized and aged wood selected in a single event (Morgan 1983). If coppicing had taken place, the patterning of the ring counts suggests it was similar to modern 'simple' or 'short rotation' coppice where the wood is harvested on rotations of less than ten years producing wood for hurdles, spars and wicker work (Evans 1984).

Medieval period

After an apparent hiatius in burnt mounds use between the Late Iron Age and Early Christian period (c. 200 BC to AD 700) (Wheeler *et al.* 2016), activity resumed with BM9025 at AD 663-859 (GU-17356) (Figure 2). Unfortunately, there is no charcoal evidence available for this burnt mound. There is charcoal data available for later burnt mounds BM9032, BM9518 and BM9575; used between AD 1025-1157 (GU-17349) to AD 1041-1220 (GU-17375). Charcoal evidence shows an increase in the use of alder with small branch wood of this tree-type being the main fuel source (Figure 8), while trunk wood of alder was also used for fuel at BM9032 (in use between AD 1025-1157 (GU-17349) and AD 1033-1204 (GU-17366)). Only branch wood was used for fuel at the other burnt mounds during this period. Hazel and willow are also represented in significant amounts, while oak and cherry are utilised more sparsely in this period. The macroscopic charcoal indicates that it is still branch wood being sought for fuel, although there is evidence for alder trunkwood being utilised. Any impact on woodland is not that evident in the pollen diagram (Figure 5) but the activity initially coincides with a peak in microscopic charcoal (40 cm) before it declined (Figure 5). The trough wood identifications (Figure 9) also show an increased use of alder, while ash was also used within Trough 9087 (associated with BM9190) despite *Fraxinus* only being represented as a rare taxon in the pollen diagram.

The medieval troughs are generally slightly smaller than later prehistoric structures, although there is some parity in depth, with troughs ranging from 0.22 to 0.35 m deep. The bases of all three troughs are lined with split planks whilst revetting survived in two troughs. Trough 9087 is revetted by horizontal planks laid on edge and held in place by retaining stakes, similar to the Middle Bronze Age/Late Bronze Age trough 9819. The timbers from trough 9087 have the long, flat facets that suggest the use of an iron tool (Coles *et al.* 1978; Sands 1997). 18 tool marks were recorded from 16 pieces of wood (6.6% of total wood assemblage), which seems to be a somewhat low incidence of tool marks given that 117 items (48.1%) show evidence of having been trimmed with an edged tool. Trough 9590 represents a new form of revetting, with vertically set split planks. As with the Middle Bronze Age/Late Bronze Age assemblage, there is no evidence for wattle work from this phase.

Placing burnt mounds into a wider landscape setting

The pollen diagrams (BG-M1 and in Wheeler *et al*. 2016) indicate that the burnt mounds were utilised in at least partially open conditions, possibly at the woodland edge. The herbaceous pollen assemblages suggest these openings comprised fen and/or wet pasture. Taxa associated with disturbance and pasture are recorded in both pollen assemblages from Ballgawley, albeit in trace amounts, during the period of burnt mound use. The occurrence of coprophilous fungal spores also suggests animals were present locally except between 110 BC and AD 450 reinforcing Wheeler et al's (2016) assertion that burnt mounds were associated with a pastoral economy for the most part since the Neolithic period. Low level grazing has been consistently recorded at other burnt mound locations (see Brown *et al.*, 2016).

Based on the radiocarbon dates, burnt mound use appears to have continued throughout the Bronze Age at Ballygawley, with little evidence of a cessation of activity between the 14 and 11th centuries BC (Ó Néill 2005; Plunkett, 2009) and archaeological finds elsewhere in the County attest to a human presence with metalwork hoards e.g. a small Bishopsland hoard at Skelly, a Co Tyrone Hoard (Eogan, 1983) and settlements e.g. Ballynagilly, Killymoon, Lough Eskragh (Williams and Pilcher, 1978; Pilcher and Smith, 1979; Hurl, 1995; Plunkett, 2009).

Overall, the evidence for human activity in the palynological records is mute, especially given the close proximity of the archaeology at Ballygawley. Charred cereal grain of naked barley has been radiocarbon dated to 1607-1417 BC (GU-17364) associated with BM9009 (Figure 2; Table SI1) suggesting that some agriculture was taking place in the wider landscape during the Neolithic and Bronze Age. At Ballygawley, cereal-type pollen is found at both sites: in this study around 2820 to 2000 BC and of indeterminate age in the other pollen diagram presented in Wheeler *et al.* (2016). The poor dispersal ability of large grasses and cereal pollen, combined with relatively dense woodland, might have dampened any cultivation signal in the pollen record (Vuorela 1973; Tweddle *et al.* 2005).

There is little change in woodland cover until 1725 BC and more rapidly from c. 900 BC when there is evidence of clearance, possibly by felling, most probably for pasture (but the pollen signal is still weak). Plunkett (2009) suggests that the Middle Bronze Age is characterised by varying degrees of intensity in mixed farming alongside the increased number of archaeological features, such as burnt mounds, but no definite intensification of farming can be discerned in the pollen records, including at Ballygawley. Evidence for farming was also observed in the pollen record from Slieve Gallion from 3300 BC onwards (Pilcher, 1973). Some woodland regeneration is seen at some sites including Beaghmore, Co Tyrone (Pilcher, 1969), during the Middle to -Late Bronze Age but elsewhere human activity continues uninterrupted, including at Claraghmore (Plunkett, 2009).

The permanent removal of alder at Ballygawley (start of LPAZ BG3pc) created a more open landscape in the immediate vicinity of the site from the early Iron Age onwards with evidence for pastoral activities. Evidence of carr woodland regeneration is seen in the uppermost 30 cm after the decline in microscopic charcoal c. AD 880-1145 which probably coincides with the last phases of burnt mound use at the site. This compares favourably with the current patchwork of active and abandoned farmland, together with scrub woodland described by Pilcher and Larmour (1982) at Meenadoan Nature Reserve in Co Tyrone.

The pollen record probably lacks the temporal and spatial sensitivity to detect more specific periods of burnt mound use in a floodplain context despite being relatively close (within tens of metres) to these kind of features. This may be the result of several factors. The pollen sampling resolution may be insufficient to detect a strong signal of burnt mound use or its impact, especially in the non-arboreal pollen record, as the individual pollen samples could represent up to 200 years thereby diluting a palynological response from sites that could have been used only occasionally or for short periods of time. The time interval between pollen samples could also represent up to 125 years at BG-M1 could simply the too great to fully capture the true extent of burnt mound use at Ballgawley, especially as the scale and intensity of burnt mound use has not been fully established as only part of the site was excavated. More sites may be buried beneath the floodplain deposits. While BG-M1 and those presented in Wheeler et al (2016) provide an excellent broad-scale picture of environmental and vegetational changes in an area of known burnt mound use, they still may lack, or show only weakly, the anthropogenic signature expected in deposits very close to an archaeological site (Edwards 1991; Amorosi et al 1998; Erlendsson et al. 2006). The results from this investigation suggest it would be very difficult to knowingly detect burnt mound use using 'off-site' palynological records, especially if the archaeological evidence was absent. In this sense, and despite the relative wealth of burnt mounds found at Ballgawley, the non-arboreal pollen records appear to only represent small-scale activity which implies the burnt mounds had little impact, except possibly on alder-carr, and that fine resolution pollen analysis may be the only viable way to generate palynological reconstructions of their impact (cf. Davies and Tipping, 2004).

Wheeler *et al.* (2016) suggested that a common set of features in the pollen and NPP records at both sites which appear to be associated with the burnt material where possibly diagnostic. These were: i) regular fluctuations in the pollen of the tree and shrub taxa, thought to be indicative of woodland management, which are not seen in the record presented here even though there is evidence for coppicing in the wood data, ii) heightened values cross-fraction micro-charcoal which are observed here and do correlate with phases of burnt mounds use but not all of them, iii) greater presence of wood detritus typified by increased values of NPPs, especially HdV-114. It is present in the BG-M1 pollen diagram but it is not always associated with high microscopic charcoal values, and neither is *Sordaria*-type (HdV-55A) which has been used as an indicator of dead wood or dung, iv), herbivore presence. The only obligate dung spore recorded was *Cercophora*-type in trace amounts at BG-M1 and out with the main phase of burning and possible burnt mound use. *Sordaria*-type is recorded in higher percentages but is largely absent from between 90 and 50 cm and v), elevated eutrophy, of which there is no substantive evidence in the NPP data presented here. Many of these supposed indicators appear, therefore, to be spatially restricted, as BG-M1 was through a palaeochannel sequence whereas monolith 2 (presented in Wheeler *et al.* 2016; Figure 1) was sampled through a burnt mound deposit located tens of metres away from BG-M1.

CONCLUSIONS

1. The combination of charcoal, wood working evidence and pollen data have led to an increased understanding of woodland resource use at burnt mound sites.
2. The location of Ballygawley was a place in the landscape where burnt mound use continued for millennia.
3. The findings from macroscopic charcoal suggests the most abundant trees - alder and hazel- were most exploited.
4. Two periods of high microscopic charcoal were identified. The first coincides with a permanent decrease in alder-carr woodland during a period of near continuous burnt mound use between 1725 and 530 BC and a second phase

occurs at approximately AD 880 and corresponds to the end of the penultimate phase of burnt mound use.

5. Notwithstanding the small sample size, evidence from the worked wood (rods and wattling) suggests that some form of woodland management or selection was used for hazel from the Neolithic onwards.
6. A multi-proxy approach is advocated for understanding the relationship between woodland, wood and burnt mound use and could be applied to other archaeological such as mining and metallurgical sites.

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Figure captions

Figure 1 Location of study sites (a) in Northern Ireland; (b) in Co Tyrone, Northern Ireland; (c) excavation site at Ballygawley showing the palaeochannels and burnt mound sites and BG-M1. Monolith 2 for the sampling site presented in Wheeler *et al.* (2016). The black lines mark the limits of the archaeological excavation.

Figure 2 Plot of calibrated radiocarbon dates from the burnt mounds at Ballgawley, Co. Tyrone using Oxcal.

Figure 3 Stratigraphic section of the sediments in the floodplain showing the location of burnt mounds 9003 and 9009, and monolith BG-M1. The section is divided into sections for presentation but runs continuously from the top section shown to the bottom and from left to right. The position of section (D-D) is shown on Figure 1.

Figure 4 Age depth graph for BG-M1 using Clam (interpolation model) (Blaauw, 2010).

Figure 5 Percentage pollen diagram of selected trees, shrubs and microscopic charcoal from BG-M1. Rare types are indicated by a cross (+), where one cross is equal to one pollen grain. Stratigraphy based on Troels-Smith (1955).

Figure 6 Percentage pollen diagram of selected dwarf shrubs and herbs from BG-M1, Co. Tyrone. Conventions are as in Figure 4.

Figure 7 Percentage diagram of selected spores and NPPs from BG-M1. Conventions are as in Figure 4.

Figure 8 Charcoal identification and ring curvature results from burnt mounds at Ballygawley expressed as number of fragments**.**

Figure 9 Wood Identification results from worked wood recovered from Burnt Mound Troughs.

Figure 10 Iron Age trough (BM9037) showing wattle from Ballygawley, Co. Tyrone.

Table 1 Radiocarbon dates from BG-M1.

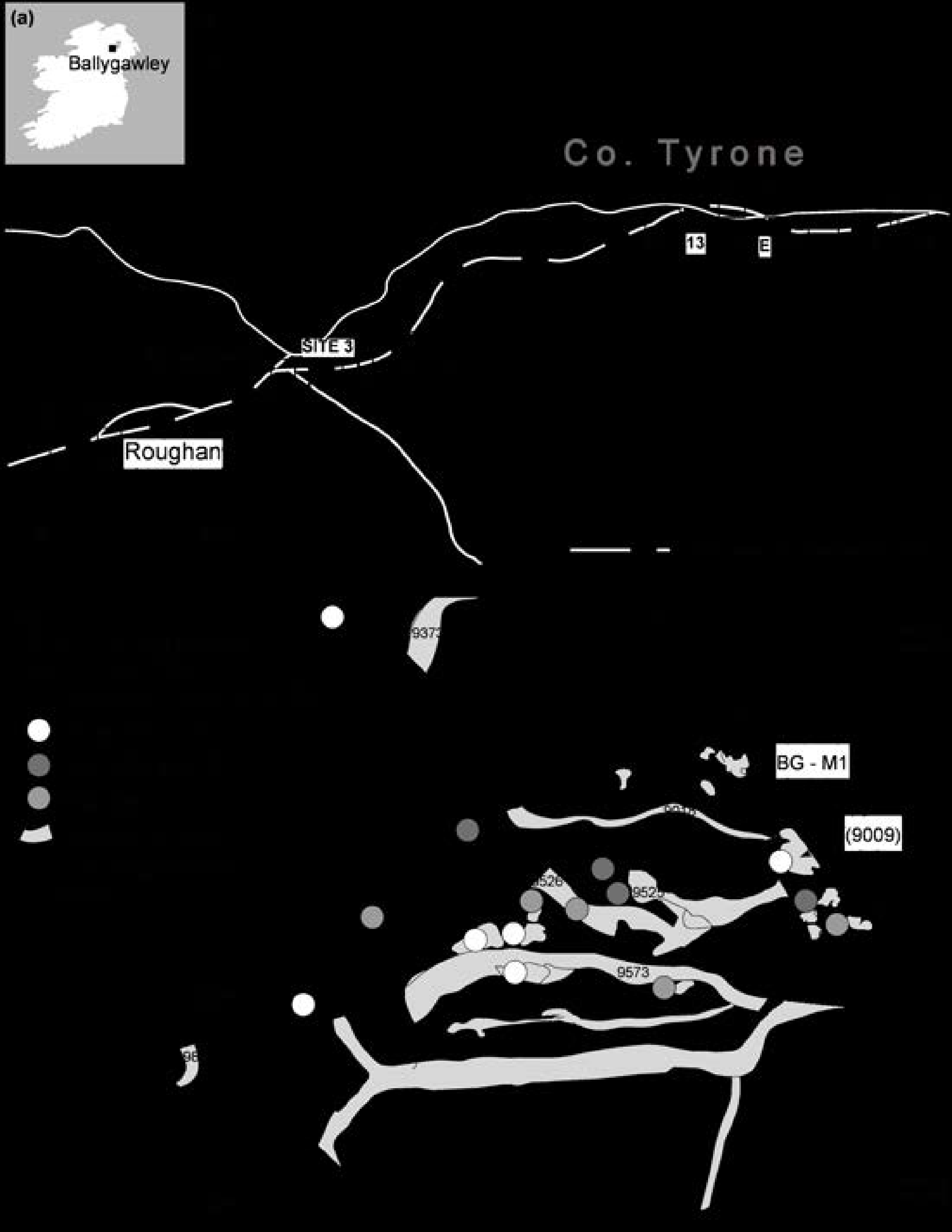
Table 2 Stratigraphy of BG-M1.

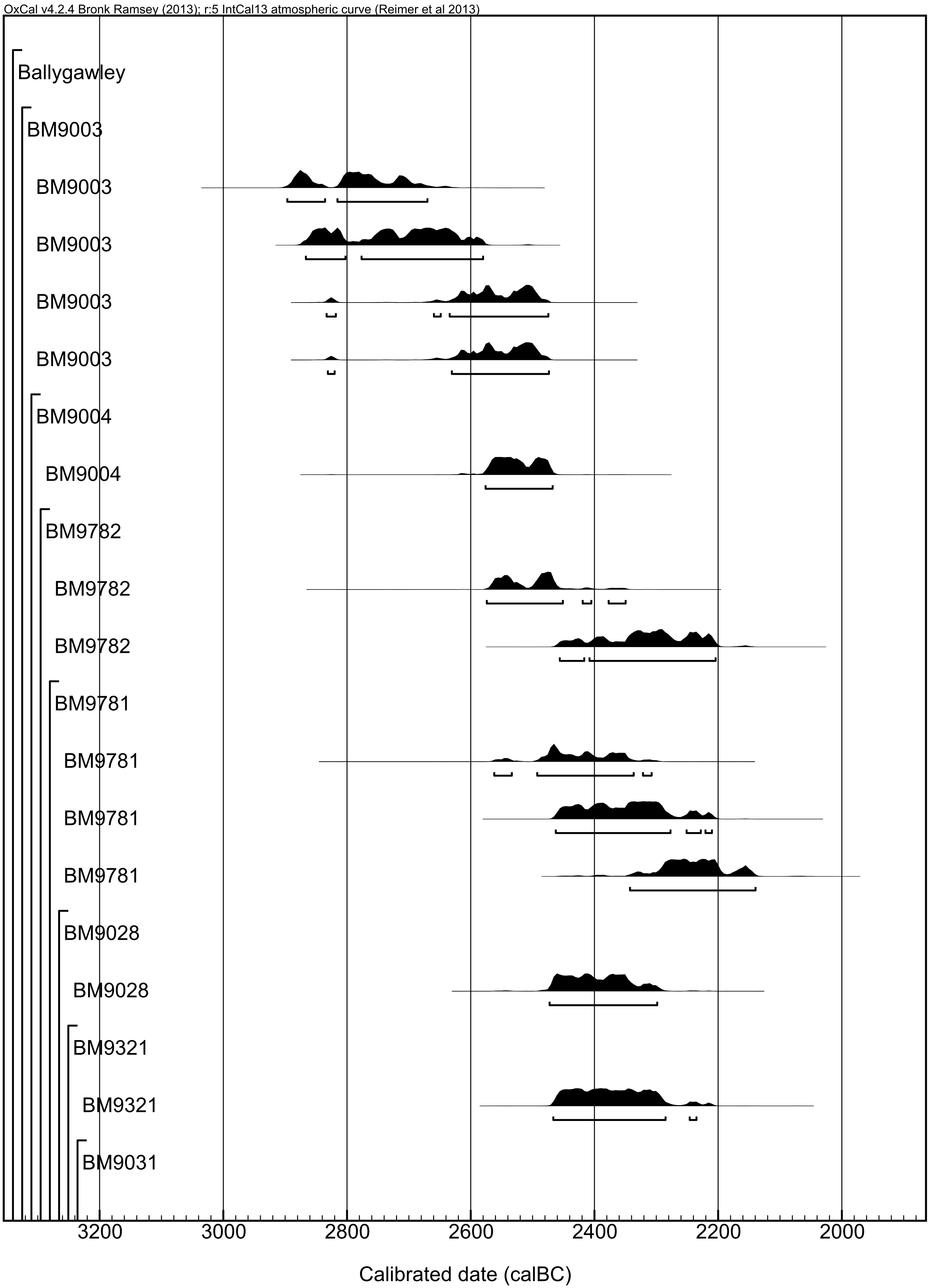
Supplementary Table 1 Radiocarbon chronology of the burnt mounds from Ballygawley, Co. Tyrone. Radiocarbon dates have been calibrated using OxCal 4.1

(Bronk Ramsey, 2009a) to 93.4% probability using IntCal04 (Bronk Ramsey, 2009b). All calibrated dates are referred to in calibrated years AD/BC.

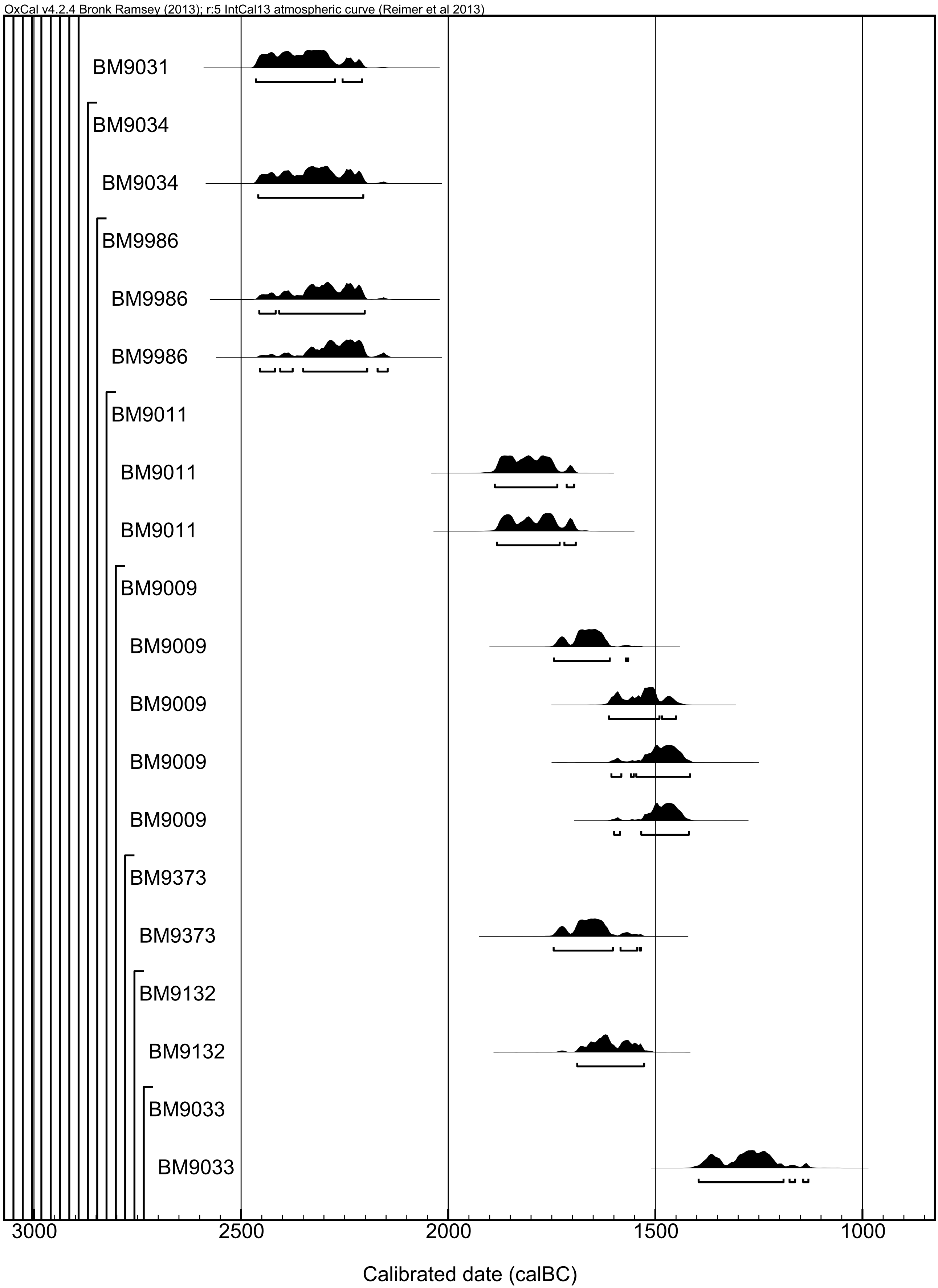
Supplementary Table 2. Radiocarbon chronology of the wood recovered from Ballygawley, Co. Tyrone. Radiocarbon dates have been calibrated using OxCal 4.1 (Bronk Ramsey, 2009a) to 93.4% probability using IntCal04 (Bronk Ramsey, 2009b). All calibrated dates are referred to in calibrated years AD/BC.

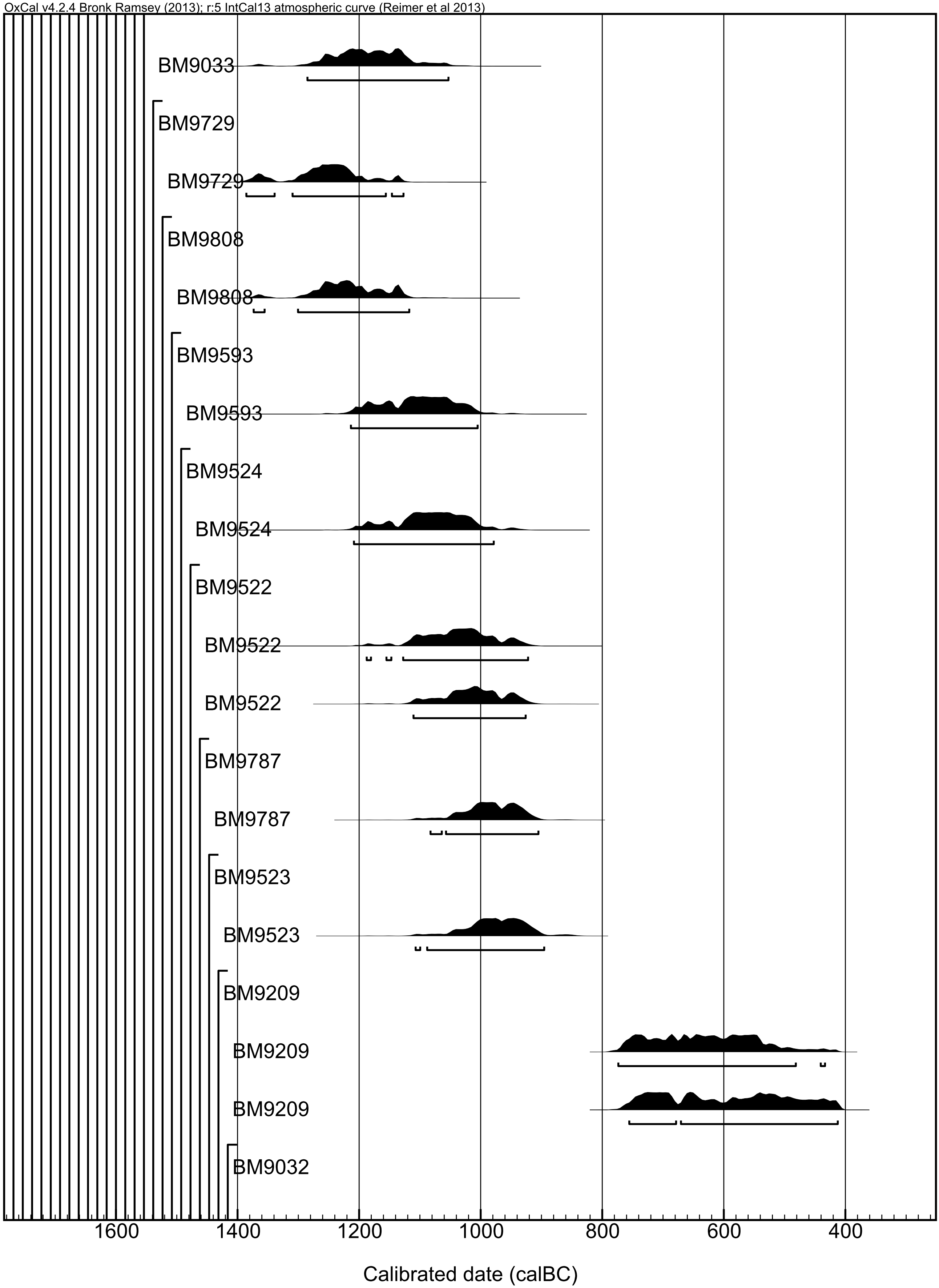
Supplementary Table 3. Radiocarbon chronology of the worked wood recovered from the burnt mounds at Ballygawley, Co. Tyrone. Radiocarbon dates have been calibrated using OxCal 4.1 (Bronk Ramsey, 2009a) to 93.4% probability using IntCal04 (Bronk Ramsey, 2009b). All calibrated dates are referred to in calibrated years AD/BC.

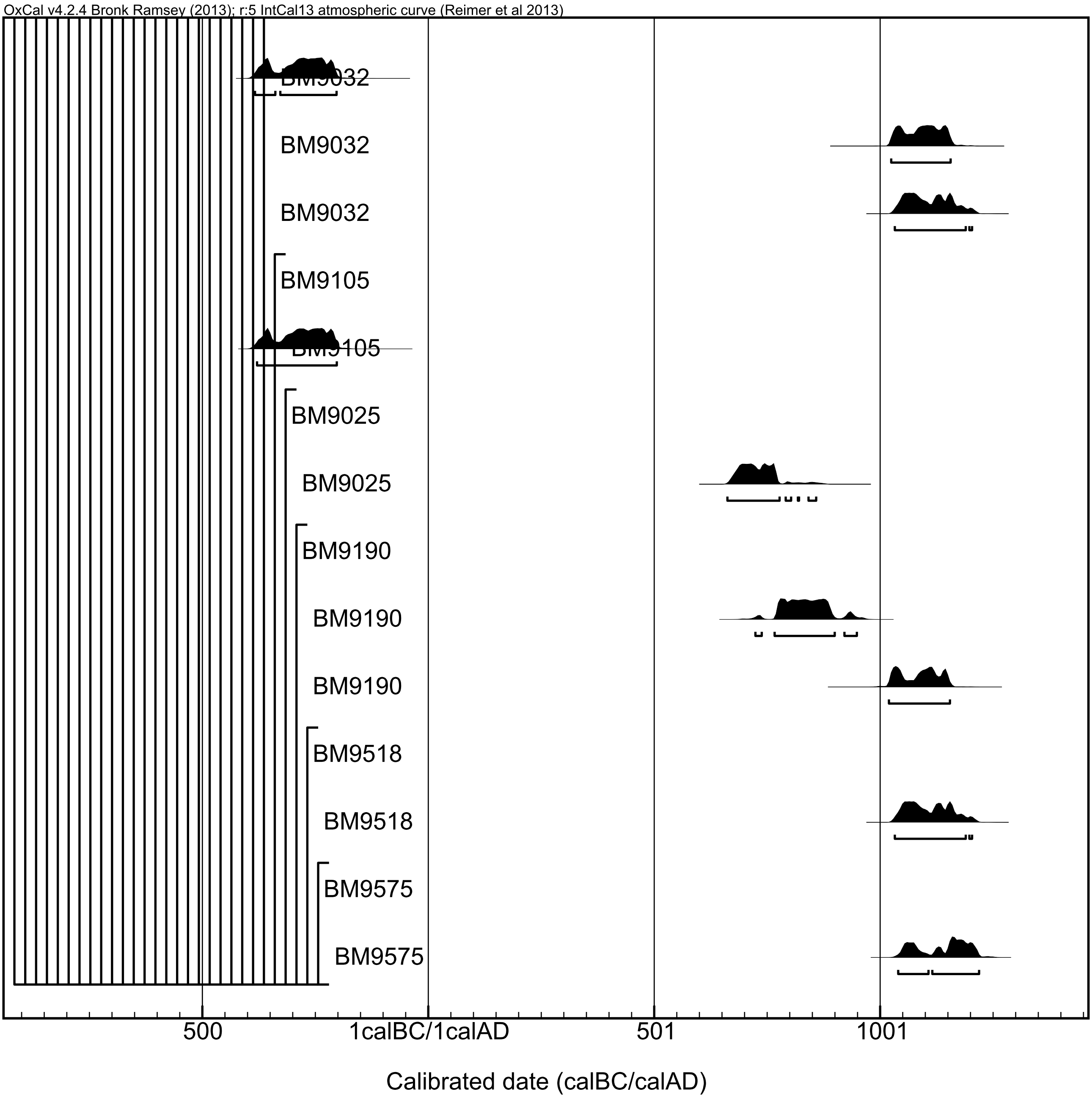

(a)
Ballygawley
Co. Tyrone
13
E
SITE 3
Roughan
BG - M1
(9009)
9573

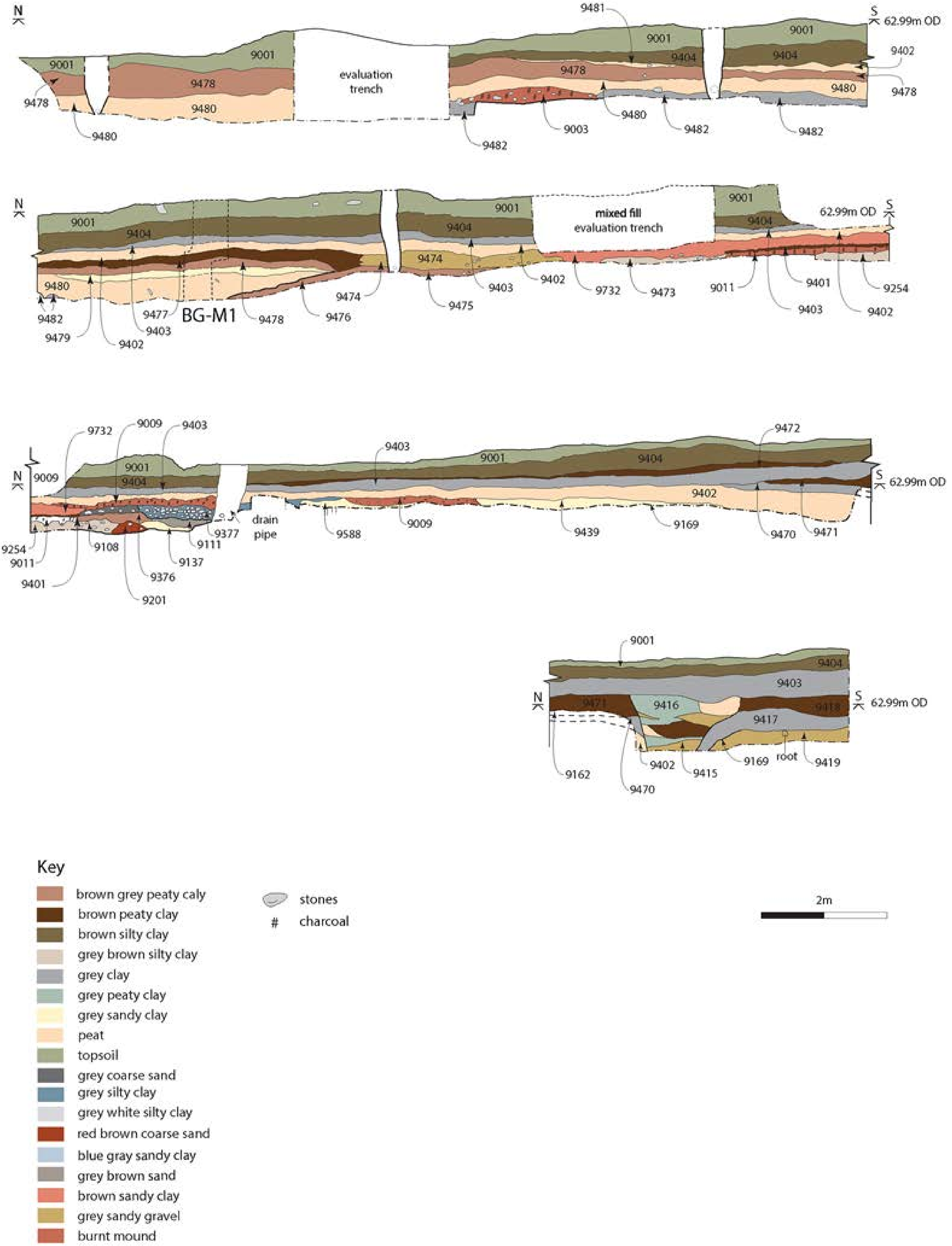


OxCal v4.2.4 Bronk Ramsey (2013); r:5 IntCal13 atmospheric curve (Reimer et al 2013)
Ballygawley
BM9003
BM9003
BM9003
BM9003
BM9003
BM9004
BM9004
BM9782
BM9782
BM9782
BM9781
BM9781
BM9781
BM9781
BM9028
BM9028
BM9321
BM9321
BM9031
3200
3000
2800
2600
2400
2200
2000
Calibrated date (calBC)

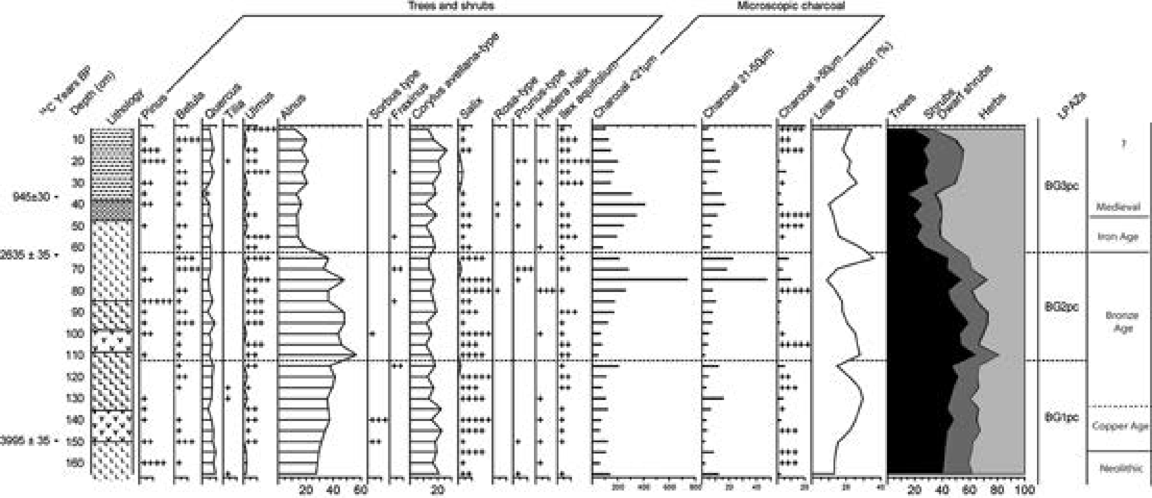

OxCal v4.2.4 Bronk Ramsey (2013); r:5 IntCal13 atmospheric curve (Reimer et al 2013)
BM9031
BM9034
BM9034
BM9986
BM9986
BM9986
BM9011
BM9011
BM9011
BM9009
BM9009
BM9009
BM9009
BM9009
BM9373
BM9373
BM9132
BM9132
BM9033
BM9033
3000
2500
2000
1500
1000
Calibrated date (calBC)


OxCal v4.2.4 Bronk Ramsey (2013); r:5 IntCal13 atmospheric curve (Reimer et al 2013)
BM9033
BM9729
BM9729
BM9808
BM9808
BM9593
BM9593
BM9524
BM9524
BM9522
BM9522
BM9522
BM9787
BM9787
BM9523
BM9523
BM9209
BM9209
BM9209
BM9032
1600
1400
1200
1000
800
600
400
Calibrated date (calBC)

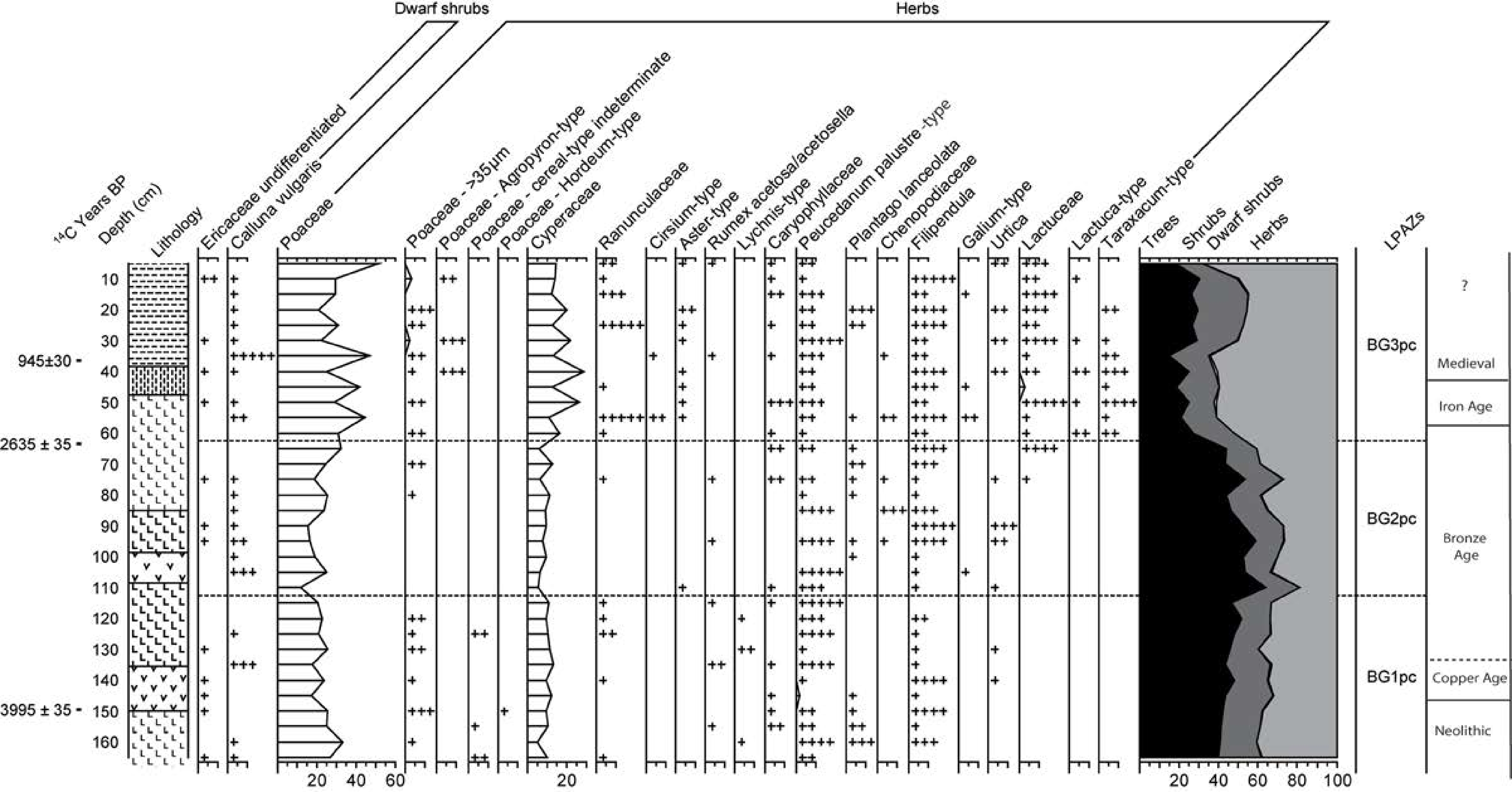

OxCal v4.2.4 Bronk Ramsey (2013); r:5 IntCal13 atmospheric curve (Reimer et al 2013)
BM9032
BM9032
BM9032
BM9105
BM9105
BM9025
BM9025
BM9190
BM9190
BM9190
BM9518
BM9518
BM9575
BM9575
500
1calBC/1calAD
501
1001
Calibrated date (calBC/calAD)



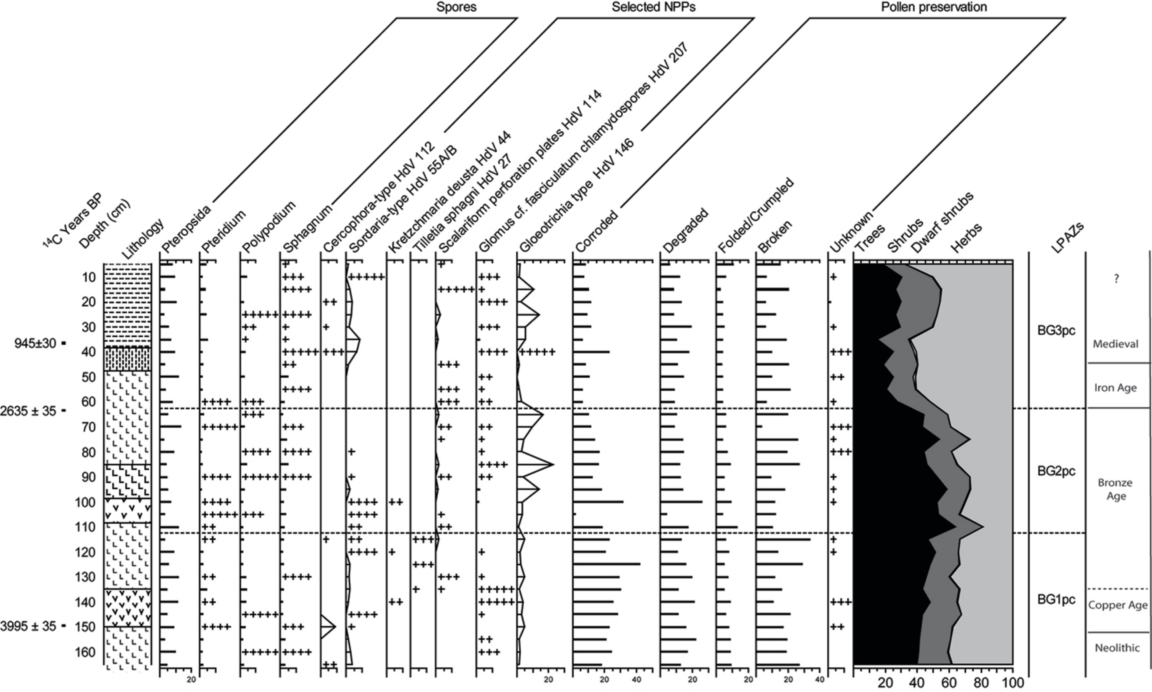
N
S
62.99m OD
9001
9404
9478
9480
9481
9402
9482
9003
evaluation trench
mixed fill
evaluation trench
BG-M1
9403
9474
9475
9476
9477
9479
9732
9473
9011
9401
9254
9009
9108
9111
9137
9376
9201
9377
drain pipe
9588
9439
9169
9470
9471
9472
9416
9417
9418
9415
9419
9162
root
Key
brown grey peaty caly
brown peaty clay
brown silty clay
grey brown silty clay
grey clay
grey peaty clay
grey sandy clay
peat
topsoil
grey coarse sand
grey silty clay
grey white silty clay
red brown coarse sand
blue gray sandy clay
grey brown sand
brown sandy clay
grey sandy gravel
burnt mound
stones
charcoal
2m



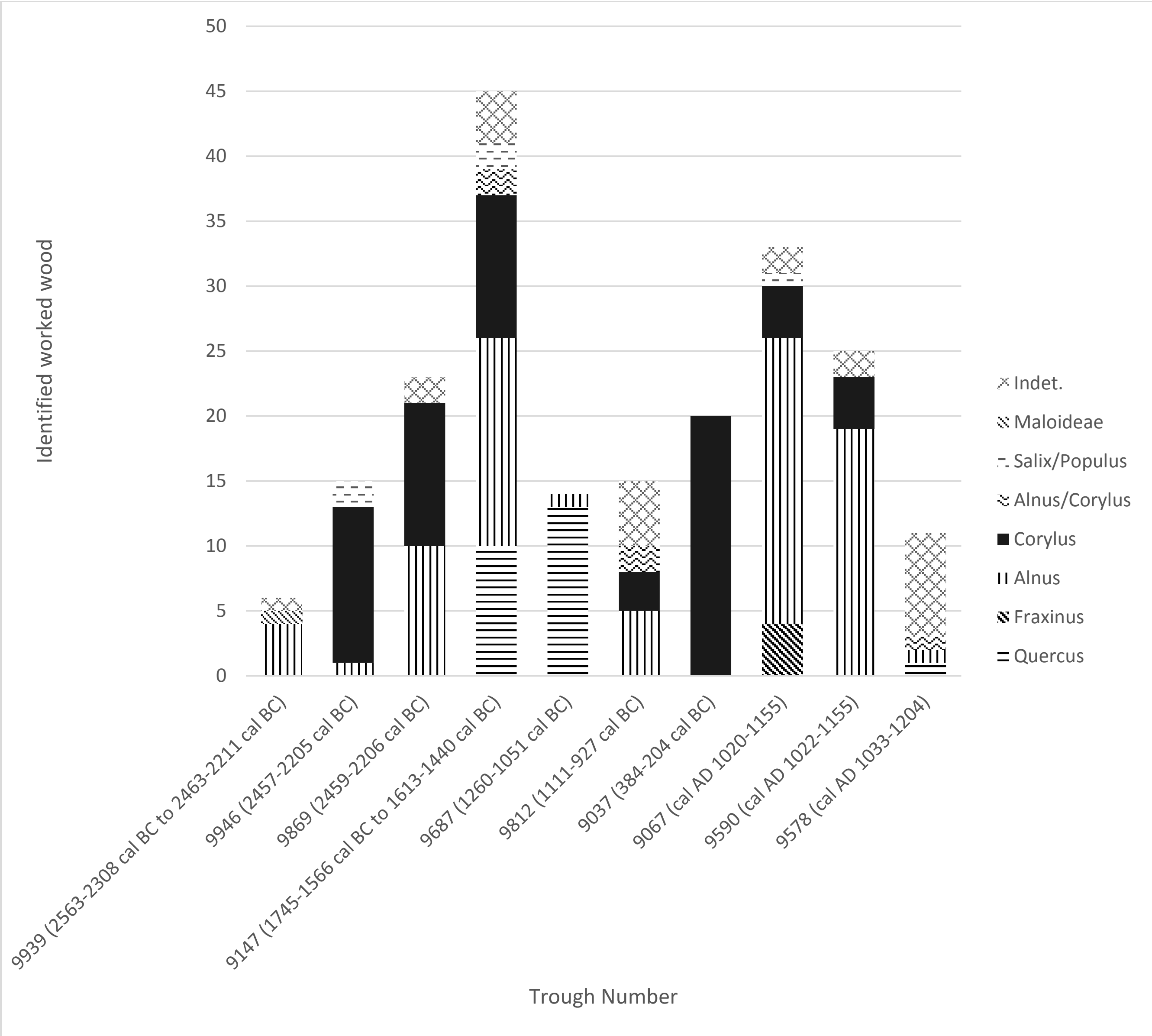
Trees and shrubs
Microscopic charcoal
¹⁴C Years BP
Depth (cm)
Lithology
Pinus
Betula
Quercus
Tilia
Ulmus
Alnus
Sorbus type
Fraxinus
Corylus avellana-type
Salix
Rosa-type
Prunus-type
Hedera helix
Ilex aquifolium
Charcoal <21µm
Charcoal 21-50µm
Charcoal >50µm
Loss On Ignition (%)
Trees
Shrubs
Dwarf shrubs
Herbs
LPAZs
945±30
2635 ± 35
3995 ± 35
BG3pc
BG2pc
BG1pc
?
Medieval
Iron Age
Bronze Age
Copper Age
Neolithic



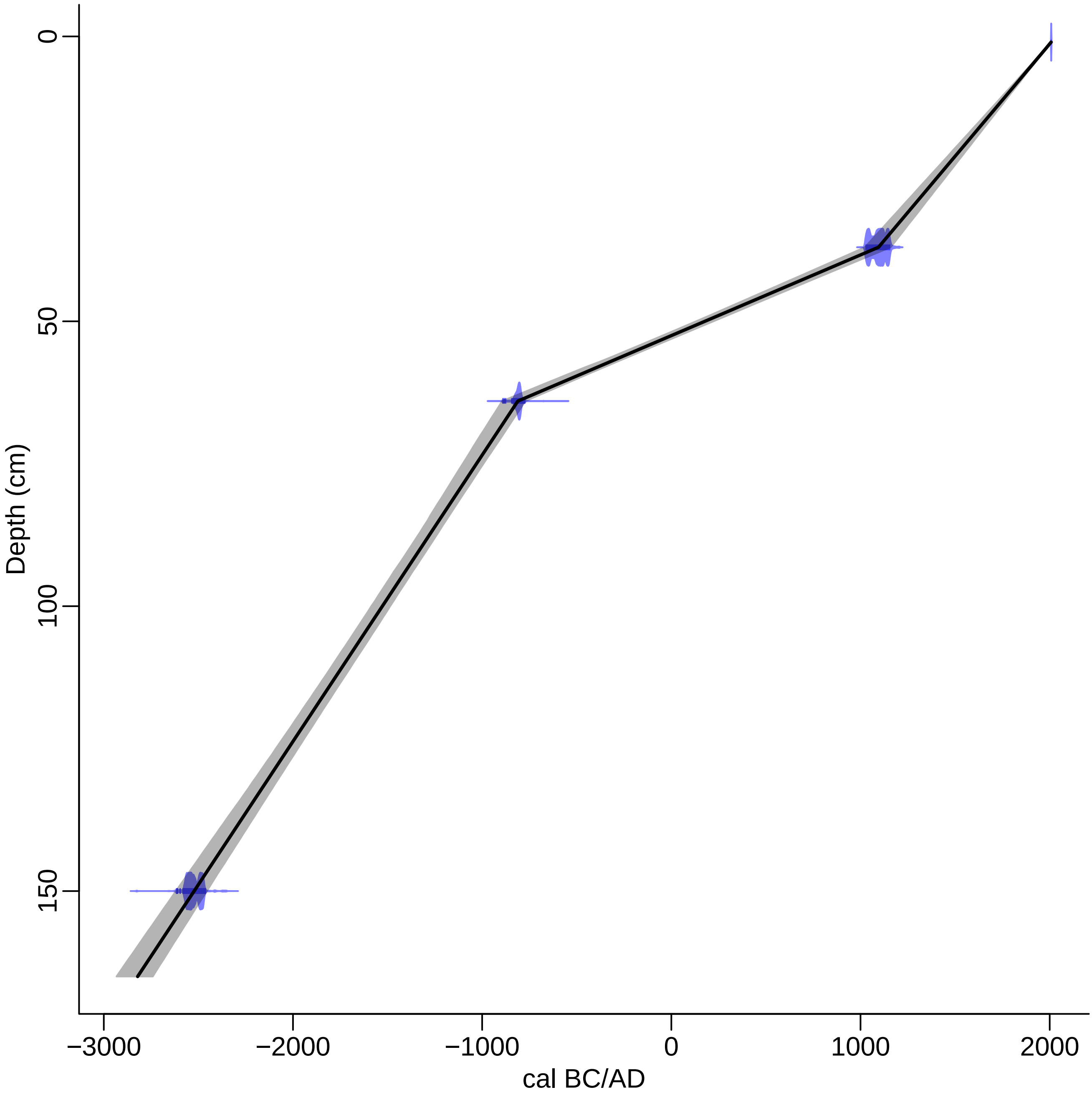
Dwarf shrubs
Herbs
14C Years BP
Depth (cm)
Lithology
Ericaceae undifferentiated
Calluna vulgaris
Poaceae
Poaceae - >35µm
Poaceae - Agropyron-type
Poaceae - cereal-type indeterminate
Poaceae - Hordeum-type
Cyperaceae
Ranunculaceae
Cirsium-type
Aster-type
Rumex acetosa/acetosella
Lychnis-type
Caryophyllaceae
Peucedanum palustre -type
Plantago lanceolata
Chenopodiaceae
Filipendula
Galium-type
Urtica
Lactuceae
Lactuca-type
Taraxacum-type
Trees
Shrubs
Dwarf shrubs
Herbs
LPAZs
945±30
2635 ± 35
3995 ± 35
BG3pc
BG2pc
BG1pc
?
Medieval
Iron Age
Bronze Age
Copper Age
Neolithic

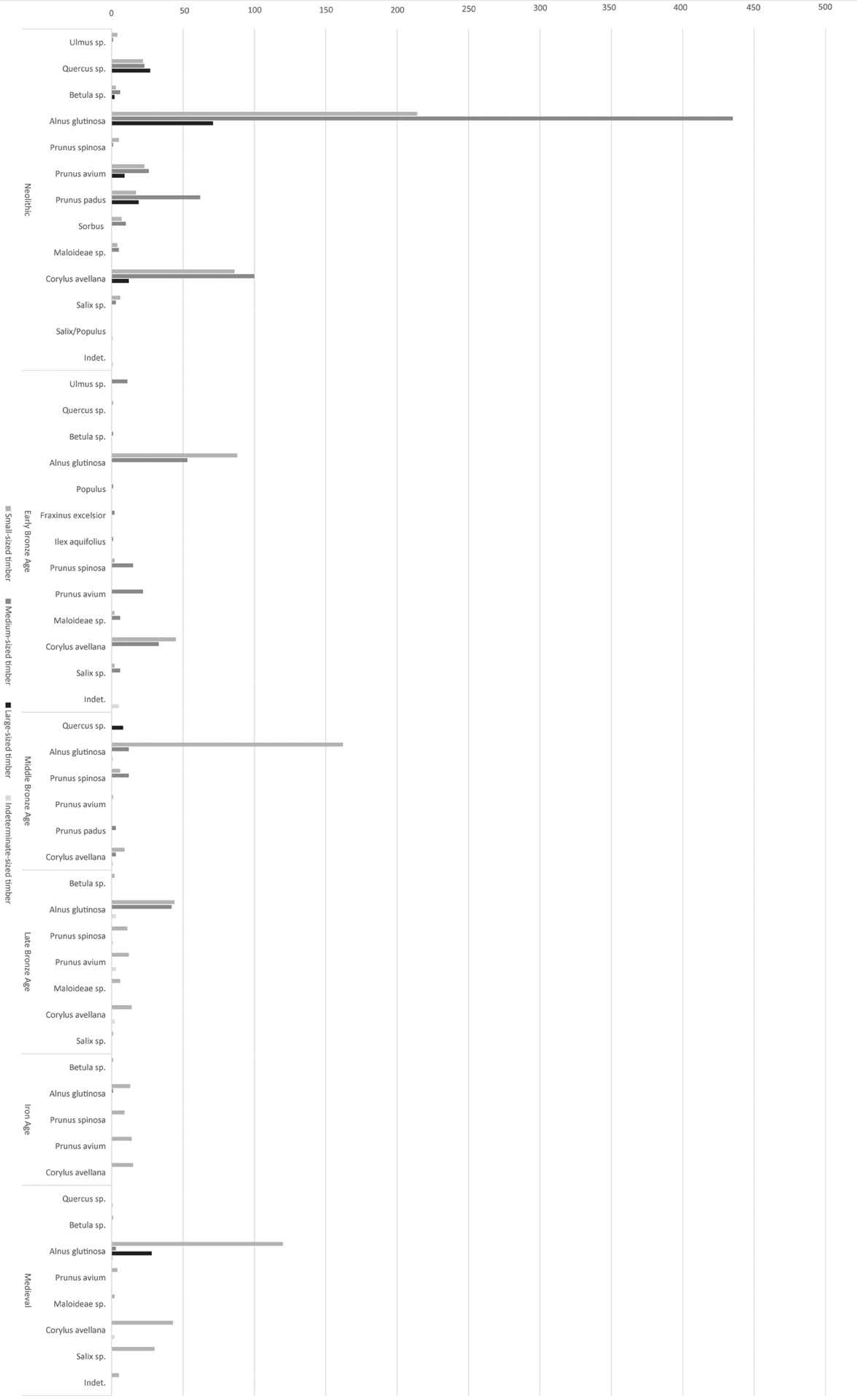


Spores
Selected NPPs
Pollen preservation
14C Years BP
Depth (cm)
Lithology
Pteropsida
Pteridium
Polypodium
Sphagnum
Cercophora-type HdV 112
Sordaria-type HdV 55A/B
Kretzchmaria deusta HdV 44
Tilletia sphagni HdV 27
Scalariform perforation plates HdV 114
Glomus cf. fasciculatum chlamydospores HdV 207
Gloeotrichia type HdV 146
Corroded
Degraded
Folded/Crumpled
Broken
Unknown
Trees
Shrubs
Dwarf shrubs
Herbs
LPAZs
945±30
2635 ± 35
3995 ± 35
BG3pc
BG2pc
BG1pc
?
Medieval
Iron Age
Bronze Age
Copper Age
Neolithic



50
45
40
35
30
25
20
15
10
5
0
Identified worked wood
Indet.
Maloideae
Salix/Populus
Alnus/Corylus
Corylus
Alnus
Fraxinus
Quercus
9939 (2563-2308 cal BC to 2463-2211 cal BC)
9946 (2457-2205 cal BC)
9869 (2459-2206 cal BC)
9147 (1745-1566 cal BC to 1613-1440 cal BC)
9687 (1260-1051 cal BC)
9812 (1111-927 cal BC)
9037 (384-204 cal BC)
9067 (cal AD 1020-1155)
9590 (cal AD 1022-1155)
9578 (cal AD 1033-1204)
Trough Number


0
50
100
150
Depth (cm)
−3000
−2000
−1000
0
1000
2000
cal BC/AD



0
50
100
150
200
250
300
350
400
450
500
Neolithic
Ulmus sp.
Quercus sp.
Betula sp.
Alnus glutinosa
Prunus spinosa
Prunus avium
Prunus padus
Sorbus
Maloideae sp.
Corylus avellana
Salix sp.
Salix/Populus
Indet.
Early Bronze Age
Ulmus sp.
Quercus sp.
Betula sp.
Alnus glutinosa
Populus
Fraxinus excelsior
Ilex aquifolius
Prunus spinosa
Prunus avium
Maloideae sp.
Corylus avellana
Salix sp.
Indet.
Middle Bronze Age
Quercus sp.
Alnus glutinosa
Prunus spinosa
Prunus avium
Prunus padus
Corylus avellana
Late Bronze Age
Betula sp.
Alnus glutinosa
Prunus spinosa
Prunus avium
Maloideae sp.
Corylus avellana
Salix sp.
Iron Age
Betula sp.
Alnus glutinosa
Prunus spinosa
Prunus avium
Corylus avellana
Medieval
Quercus sp.
Betula sp.
Alnus glutinosa
Prunus avium
Maloideae sp.
Corylus avellana
Salix sp.
Indet.
Small-sized timber
Medium-sized timber
Large-sized timber
Indeterminate-sized timber

Depth (cm)	**Lab number**	**Dated Material**	**Radiocarbon Age BP**	**Date Calibrated (2σ)**	**Relative Probability**
35-36	Poz-83233	Peat (humin)	945 ± 25	cal AD 1027-1155	95.4%
63-64	GU-15846	Peat (humic acid)	2635 ± 35	894-872 cal BC	4.1%
				849-773 cal BC	91.3%
149-150	GU-15848	*Corylus avellana* nutshell	3995 ± 35	2619-2607 cal BC	1.2%
				2599-2594 cal BC	0.4%
				2586-2459 cal BC	93.8%

Table 1. Radiocarbon dating results obtained from Ballygawley, Monolith 1 (calibrated using OxCal 4.2 and IntCal 13).

Depth (cm)	Description of sediments
0-32	Brown humic earth with modern roots
32-38.5	grey-brown clayey loam
38.5-47.5	Dark brown-grey clayey peat
47.5-85	Yellow-grey silty clay
85-97	Dark brown peaty silt
97-98.5	Light brown-grey sandy silt
98.5-108.5	Dark brown-black clayey peat with occasional wood fragments
108.5-125	Dark grey clayey silt
125-135.5	Dark grey clayey silt with wood fragments
135.5-150	Dark grey-brown clayey peat with wood fragments
150-156.5	Dark grey-brown sandy, silty clay with wood fragments
156.5-168	Dark grey peaty clay with gravels and wood fragments

Burnt Mound	Sample Number	Context Number	Lab code	Dated material	σ13C	Radiocarbon Age BP	Date Calibrated (2σ)	Relative Probability
BM9030	676	9260	GU-17361	*Alnus glutinosa* charcoal	-27.1‰	4200±35	2897-2836 cal BC	27.6%
							2816-2671 cal BC	67.8%
BM9003	502	9229	GU-17339	*Quercus* charcoal	-26.2‰	4125±30	2867-2803 cal BC	25.8%
							2777-2581 cal BC	69.6%
BM9003	359	9235	GU-17348	*Alnus glutinosa* charcoal	-23.9‰	4045±30	2834-2819 cal BC	3.2%
							2660-2649 cal BC	1.6%
							2635-2475 cal BC	90.6%
BM9003	428	9244	GU-17359	*Corylus avellana* charcoal	-27.3‰	4040±30	2832-2821 cal BC	2.0%
							2631-2474 cal BC	93.4%
BM9004	360	9004	GU-17358	*Alnus glutinosa* charcoal	-27.6‰	4000±30	2577-2468 cal BC	95.4%
BM9782	1120	9892	GU-17380	*Salix* charcoal	-26.3‰	3970±30	2575-2452 cal BC	90.4%
							2420-2460 cal BC	1.9%
							2378-2350 cal BC	3.2%
BM9782	1469	9961	GU-18406	*Corylus avellana* waterlogged timber	-28.4‰	3845±30	2457-2471 cal BC	10.3%
							2409-2205 cal BC	85.1%
BM9781	1718	9975	GU-18407	*Alder glutinosa* waterlogged timber	-27.5‰	3935±30	2563-2534 cal BC	5.5%
							2493-2337 cal BC	87.8%
							2322-2308 cal BC	2.0%
BM9781	1716	9957	GU-18405	*Alder glutinosa* waterlogged timber	-28.9‰	3865±30	2463-2278 cal BC	87.6%
							2252-2229 cal BC	5.7%
							2221-2211 cal BC	2.1%
BM9781	1119	9879	GU-17379	*Alnus glutinosa charcoal*	-28.7‰	3805±30	2343-2140 cal BC	95.4%
BM9028	659	9355	GU-17346	*Alnus glutinosa* charcoal	-25.3‰	3910±30	2473-2299 cal BC	95.4%
BM9321	669	9323	GU-17345	*Alnus glutinosa* charcoal	-27.4‰	3880±30	2467-2286 cal BC	94.2%

Burnt Mound	Sample Number	Context Number	Lab code	Dated material	σ13C	Radiocarbon Age BP	Date Calibrated (2σ)	Relative Probability
							2247-2236 cal BC	1.2%
BM9031	176	9031	GU-17350	*Corylus avellana* charcoal	-25.9‰	3865±35	2465-2247 cal BC	84.2%
							2256-2209 cal BC	11.2%
BM9034	1466	9876	GU-17381	*Alnus glutinosa* charcoal	-25.4‰	3850±35	2459-2206 cal BC	95.4%
BM9986	1772	9986	GU-17382	*Alnus glutinosa* charcoal	-26.0‰	3840±30	2457-2417 cal BC	8.4%
							2409-2202 cal BC	87.0%
BM9986	1430	9919	GU-18404	*Alder glutinosa* waterlogged timber	-28.6‰	3825±30	2455-2419 cal BC	3.8%
							2406-2376 cal BC	4.7%
							2351-2196 cal BC	83.4%
							2171-2147 cal BC	3.4%
BM9011	456	9272	GU-18398	*Corylus avellana* waterlogged stake	-30.1‰	3480±30	1888-1737 cal BC	90.9%
							1715-1697 cal BC	4.5%
BM9011	247	9011	GU-17354	*Alnus glutinosa* charcoal	-25.5‰	3465±30	1883-1732 cal BC	84.4%
							1720-1693 cal BC	11.0%
BM9009	513	9147	GU-18396	*Quercus* waterlogged wood	-26.2‰	3370±30	1745-1611 cal BC	94.8%
							1572-1566 cal BC	0.6%
BM9009	440	9208	GU-18397	*Alder glutinosa* waterlogged timber	-28.5‰	3250±30	1613-1491 cal BC	80.5%
							1485-1451 cal BC	14.9%
BM9009	764	9009	GU-17364	Charred grain *Hordeum vulgare var nudum*	-24.0‰	3215±35	1607-1583 cal BC	4.8%
							1560-1553 cal BC	0.9%
							1547-1417 cal BC	89.7%
BM9009	794	9555	GU-18399	*Corylus avellana* waterlogged stake	-26.4‰	3215±30	1600-1586 cal BC	2.4%
							1535-1420 cal BC	93.0%
BM9373	775	9539	GU-17363	*Alnus glutinosa* charcoal	-26.7‰	3365±35	1746-1603 cal BC	88.4%
							1585-1544 cal BC	6.7%

Burnt Mound	Sample Number	Context Number	Lab code	Dated material	σ13C	Radiocarbon Age BP	Date Calibrated (2σ)	Relative Probability
							1538-1535 cal BC	0.4%
BM9132	181	9132	GU-17351	*Alnus glutinosa* charcoal	-27.2‰	3330±30	1689-1528 cal BC	95.4%
BM9033	256	9174	GU-17355	*Alnus glutinosa* charcoal	-25.6‰	3025±35	1396-1191 cal BC	91.8%
							1177-1163 cal BC	1.6%
							1144-1131 cal BC	2.0%
BM9033	254	9095	GU-17347	*Corylus avellana* charcoal	-21.4‰	2970±35	1286-1054 cal BC	95.4%
BM9729	1063	9801	GU-17377	*Alnus glutinosa* charcoal	-27.4‰	3010±30	1386-1340 cal BC	12.2%
							1310-1157 cal BC	78.9%
							1147-1128 cal BC	4.4%
BM9808	1041	9809	GU-17376	*Alnus glutinosa* charcoal	-28.1‰	2990±30	1374-1356 cal BC	2.6%
							1301-1118 cal BC	92.8%
BM9593	946	9593	GU-17372	*Alnus glutinosa* charcoal	-26.8‰	2910±35	1214-1006 cal BC	95.4%
BM9524	834	9595	GU-17367	*Alnus glutinosa* charcoal	-27.2‰	2895±35	1209-979 cal BC	95.4%
BM9522	1024	9814	GU-17374	*Alnus glutinosa* charcoal	-27.2‰	2865±35	1188-1181 cal BC	0.7%
							1156-1148 cal BC	0.8%
							1128-923 cal BC	93.9%
BM9522	1017	9819	GU-18403	Indet. waterlogged timber	-28.9‰	2850±30	1111-927 cal BC	95.4%
BM9787	862	9788	GU-17369	*Salix* charcoal	-25.8‰	2830±30	1083-165 cal BC	1.8%
							1058-906 cal BC	93.6%
BM9523	851	9523	GU-17368	*Corylus avellana* charcoal	-24.1‰	2820±35	1108-1100 cal BC	0.6%
							1089-896 cal BC	94.8%
BM9029	644	9363	GU-17343	*Alnus glutinosa* charcoal	-25.8‰	2480±30	774-482 cal BC	94.9%
							441-434 cal BC	0.5%

Burnt Mound	Sample Number	Context Number	Lab code	Dated material	σ13C	Radiocarbon Age BP	Date Calibrated (2σ)	Relative Probability
BM9520	921	9530	GU-17370	*Betula* charcoal	-25.8‰	2455±35	756-679 cal BC	26.5%
							671-413 cal BC	68.9%
BM9025	331	9202	GU-17356	*Prunus spinosa* charcoal	-28.4‰	1270±30	cal AD 663-778	92.3%
							cal AD 792-804	1.3%
							cal AD 819-821	0.2%
							cal AD 842-859	1.6%
BM9190	316	9190	GU-17357	*Alnus glutinosa* charcoal	-26.6‰	1185±30	cal AD 725-739	1.8%
							cal AD 767-900	88.3%
							cal AD 922-949	5.3%
BM9190	334	9087	GU-18394	*Alder glutinosa* waterlogged timber	-28.6‰	960±30	cal AD 1020-1155	95.4%
BM9032	163	9078	GU-17349	*Corylus avellana* charcoal	-24.8‰	945±30	cal AD 1025-1157	95.4%
BM9032	814	9659	GU-17366	*Betula* charcoal	-27.0‰	910±30	cal AD 1033-1190	94.0%
							cal AD 1198-1204	1.4%
BM9518	970	9670	GU-18401	*Salix* waterlogged wood	-27.8‰	910±30	cal AD 1033-1190	94.0%
							cal AD 1198-1204	1.4%
BM9575	1038	9575	GU-17375	*Quercus* charcoal	-25.9‰	885±30	cal AD 1041-1108	31.6%
							cal AD 1116-1220	63.8%

Trough	**Sample Number**	**Context Number**	**Lab code**	**Dated material**	**σ13C**	**Radiocarbon Age BP**	**Date Calibrated (2σ)**	**Relative Probability**
9687	1044	9764	GU-18402	*Quercus* waterlogged wood	-26.9‰	2950±30	1260-1241 cal BC	3.2%
							1236-1051 cal BC	92.2%
9037	241	9077	GU-18393	*Corylus avellana* waterlogged wood	-28.9‰	2230±30	384-339 cal BC	20.8%
							328-204 cal BC	74.6%
9037	678	9140	GU-18395	*Salix* waterlogged wood	-27.9‰	2225±30	380-203 cal BC	95.4%
9590	974	9630	GU-18400	*Alnus glutinosa* waterlogged wood	-27.3‰	955±30	cal AD 1022-1155	95.4%

Burnt Mound	Trough	Preservation Score	Radiocarbon Dates from Timbers (2σ)	Construction Style	Measurements (m)	Evidence for Wood Working	Evidence for Woodland Management?
BM9781	9939	1-3	2563-2308 cal BC (GU-18407) to 2463-2211 cal BC (GU-18405)	Oval trough with double lined timber floor and possible wattle lining. All of the upper flooring is converted with 1 radial half split, 1 radial third split and 3 tangentially aligned. Of the basal flooring all but one timber is converted with a variety of conversations including 1 timber hewn at one end into boxed heart, 1 radial split, a radial third split, 2 tangentially aligned. One timber is charred on both faces. Upper flooring is *Alnus* and *Corylus*; basal flooring is *Alnus* and Maloideae. Wattle is unidentified.	1.40 x 1.10 x 0.26	Two timbers with ends worked into ‘oar-shape’ inserted into deposits to secure timbers.	None.
BM9782	9946	2-4	2457-2205 cal BC (GU-18406)	Wattle-lined oval trough, second phase of use of initial pit. Roundwood recovered from base of feature may include elements of wattle revetting.	1.00 x 1.05 x 0.20	Wattle sails have all had lower ends worked into points. Tool facets indicate stone tools used. One tool mark recorded.	*Corylus* wattle possibly derived from coppice. Length of sails between 230-280mm and diameters of 25-500mm. Two roundwoods may

Burnt Mound	Trough	Preservation Score	Radiocarbon Dates from Timbers (2σ)	Construction Style	Measurements (m)	Evidence for Wood Working	Evidence for Woodland Management?
				Wattle is all *Corylus.* Roundwood is *Alnus*, *Corylus* and *Salix/Populus*			represent either coppice rods or brushwood.
BM9034	9869	1-3	2459-2206 cal BC (GU-17381)* *charcoal date	Oval trough with timber floor and wattle lining. Flooring of 7 unconverted timbers, 3 radial half split and 1 radial third split. Flooring is all *Alnus* with one *Corylus* timber; wattle is *Corylus*.	1.42 x 1.27 x 0.26	Floor timbers trimmed at either both or one end. Tool marks evident on 5 timbers.	*Corylus* wattle possibly derived from coppice. All sails <250mm in length, diameters 18-30mm.
BM9009	9147 (includes 9208)	1-4	1745-1566 cal BC (GU-18396) to 1613-1440 cal BC (GU-18397) (Dendrochronological analysis cross-matched 5 of the *Quercus* timbers and gave a felling date for 1590 cal BC)	Rectangular trough with flooring of split planks, aligned with the long-axis of the trough. Wattle revetting of edge of structure Stakes driven through plank floor. Variety of conversions in the flooring; 4 are radially and tangentially aligned with a square cross-section, 4 are tangentially aligned and 2 are radially aligned. Planks are heartwood only. Flooring is all *Quercus*. Wattle is *Alnus*, *Corylus*, *Alnus/Corylus, Salix/Populus* and indeterminate.	1.62 x 1.29 x 0.25	Secondary tooling was present on 2 planks which have tool facets on one face where they have been hewn. Of the 21 wattle sails, 18 have worked ends, 14 are trimmed at one end from one direction and 4 at one end in two directions.	Wattle sails displays morphological traits indicative of potential coppice. 4 samples where rings were visible had counts of 5-10 years. Sails had lengths of 100-565mm and diameters of 11-42mm.

Burnt Mound	Trough	Preservation Score	Radiocarbon Dates from Timbers (2σ)	Construction Style	Measurements (m)	Evidence for Wood Working	Evidence for Woodland Management?
N/A	9687	2	1260-1051 cal BC (GU-18402)	Rectangular trough cut into burnt mound (BM9621). Base of trough is single large timber. Timber is tangential outer split. . A small piece of tangentially split timber was recovered under the trough timber. Large timber is *Quercus*, split timber is *Alnus*.	3.6 x 0.98 x 0.15	No surviving evidence due to poor preservation.	
BM9522	9812	2-4	1111-927 cal BC (GU-18403)	Rectangular trough lined with partially surviving wooden structure. 18 timbers were recovered from the wooden trough lining including 7 floor planks, 2 revetting planks, 5 retaining stakes and 4 pieces of debris. All 7 floor timbers have been converted. 6 are tangentially aligned with 4 modified to have a rectangular cross-section. One stake was tangentially split. A single woodchip was recovered and one piece of unclassified debris.	1.7 x 0.85 x 0.3	Basic level of wood working – no evidence of finishing or jointing. Evidence for trimming recorded on one end of a floor timber in one direction, flat across axis. All stakes worked to a point at lower end.	All of the stakes displayed morphological features associated with possible coppicing. The stakes measured between 240-360 mm in length and 60-70mm in diameter.

Burnt Mound	Trough	Preservation Score	Radiocarbon Dates from Timbers (2σ)	Construction Style	Measurements (m)	Evidence for Wood Working	Evidence for Woodland Management?
				Planks are *Alnus, Corylus* and indeterminate (due to poor preservation). Stakes are *Alnus* and *Corylus and Alnus/Corylus*. Woodchip is *Alnus*. Debris is *Alnus*.			
BM9032	9037	3	384-204 cal BC (GU-18393)	Oval trough with a wattle lined base and wattle revetting, which would have stood up to 0.5m tall around the side of the trough. A layer of moss was recorded below the wattle lining. All of the wattle examined had bark, sapwood and heartwood intact. Roundwood all *Corylus*.	2.57 x 2.12 x 0.5	Four of the examined rods had trimmed ends at one end in one direction. Excavators suggest trough constructed from a pre-formed wattle hurdle.	Wattle appears to be derived from possible coppice. 9 samples had rings visible and ranged from 2-10 years. The sails had a maximum length of 1840mm and maximum diameter of 30mm. The weavers had a maximum length of 1800mm and maximum diameter of 10-50mm.

Burnt Mound	Trough	Preservation Score	Radiocarbon Dates from Timbers (2σ)	Construction Style	Measurements (m)	Evidence for Wood Working	Evidence for Woodland Management?
BM9190	9067	1-4	cal AD 1020-1155 (GU-18394)	Square trough constructed of 9 split planks for the flooring, 9 revetting planks at the sides held by 18 retaining stakes. Floor planks are tangentially aligned splits with rectangular cross-section. Two of the revetting planks are tangentially aligned one is radially aligned, remainder of uncertain conversion. Revetting stakes have primary conversion evident; 12 stakes are tangentially aligned, 1 is a boxed heart, 1 is of uncertain conversion and 2 are unconverted. Floor planks are *Alnus* and *Fraxinus*. Revetting planks are *Fraxinus*, *Corylus*, *Alnus* and *Salix/Populus*. Revetting stakes are *Alnus*, *Corylus* and *Fraxinus*.	2.0 x 1.8 x 0.35	Little surviving tooling evidence. One floor plank has been trimmed at one end from four directions into a tapered point. Tooling visible on the revetting stakes where 13 stakes have evidence of being trimmed to a point or tapered point from 1-4 directions; in 2 cases the visible facets are flat.	The 2 unconverted wooden retaining stakes have morphological features associated with possible coppicing. The length of all the stakes vary between 90-900mm and the unconverted stakes have a diameter of 40-50mm.
N/A	9590	1-4	cal AD 1022-1155 (GU-18400)	Oval trough lined with 5 large floor planks, aligned east-west, edge of the trough revetted by 23 vertically set	N/A	Of the floor planks one is trimmed flat at one end and has tool mark	

Burnt Mound	Trough	Preservation Score	Radiocarbon Dates from Timbers (2σ)	Construction Style	Measurements (m)	Evidence for Wood Working	Evidence for Woodland Management?
				timbers. 1 floor plank is tangentially aligned and 1 is tangentially split, 2 are boxed half split and 1 is an outer tangential split. The revetting timbers are all split. 2 are of uncertain conversion, 4 are radially converted and 16 are tangentially aligned. 1 is radially and tangentially aligned with a rectangular cross-section. Floor planks are all *Alnus*. Revetment timbers are *Alnus*, *Corylus* and indeterminate.		evident. One is trimmed at one end and from one direction. Three are trimmed flat at one end and trimmed in two directions from the other and have felling scars evident. A faint signature tool mark was found on one plank. One plank has been hewn to a chamfer on one side (sapwood removal?). 12 of the revetting timbers have been worked at their lower ends. All have been worked to a point or tapered point from 1-4 directions. Tool marks were noted	

Burnt Mound	Trough	Preservation Score	Radiocarbon Dates from Timbers (2σ)	Construction Style	Measurements (m)	Evidence for Wood Working	Evidence for Woodland Management?
						from the trimmed ends of four timbers.	
BM9518	9578	1-3	cal AD 1033-1204 (GU-18401)	Oval trough with 11 floor planks and no evidence of revetting. Floor planks were radially cleft. Floor planks are *Alnus*, *Alnus/Corylus*, *Quercus* and indeterminate.	1.15 x 1.05 x 0.23	Floor planks were too decayed for survival of tool marks.	